SATURDAY, OCTOBER 6, 1928.

CONTENTS.

Life and Death.

MAN must have speculated on the meaning and source of life ever since a race of beings arose on this planet endowed with the power of reasoning, the particular form taken by his speculations depending on the stage of civilisation and culture reached. At all times there have been those—fewer now than even a century ago—who drew a sharp line of distinction between the living and the non-living, between the inorganic and the organic world ; but the advance of scientific knowledge has slowly broken down the barriers between the animate and the inanimate, first when it was discovered that organic substances, previously supposed peculiar to the tissues of living beings, could be prepared in the test-tube in exactly similar manner to inorganic compounds, until nowadays many confidently assert that the phenomena of life will be explicable in the terms of the more exact sciences. Others, more cautious perhaps, consider that though it may be possible to describe these phenomena in the terms used in mathematics, physics, or chemistry, yet such description will still not provide us with a final and complete explanation.

That the laws which govern the phenomena of life are undiscoverable, that the basis of life is some vital principle, the nature of which can never be known, is a position which few would hold to-day, leading as it does to a paralysis of the power of investigation, and refuted, as it is, by our rapidly increasing knowledge of these very phenomena. The fundamental distinction between the living and the non-living is that whilst it is possible to isolate the phenomena of the inorganic world, it is impossible to consider a living organism apart from its environment ; it is, in fact, its reactions and adaptations to changes in its surroundings which distinguish the living from the inanimate and form the basis of the science of biology.

What light, then, do the recent advances in chemistry and physics throw on the phenomena of life ? And how far are the laws of these sciences applicable to the reactions of living beings ? To a consideration of these questions Prof. Donnan applied himself in his recent evening discourse to the British Association at Glasgow. The investigations of physiologists early showed that organisms obey the laws of the conservation of matter and of energy. The energy for the heat produced and the work performed by a living being is derived from the energy value of the food consumed, by its oxidation in the presence of the oxygen taken in during respiration, and it is easy to construct a balance sheet of the incoming and outgoing energy and show that there is no credit or debit balance. Again, plants and animals conform also to the second law of thermodynamics, so far as is known at present; it is the free or available energy of their environment which is the sole source of their life and activity, and the origin of this available energy is the radiation from the sun. If this radiation were in thermal equilibrium with the average temperature of the earth's crust, practically all life as we know it would cease, since the green plant would be unable to assimilate carbon dioxide and water by the absorption of free energy by means of its contained chlorophyll, and the synthesis to sugar and starch would fail to occur. This synthesis represents an increase in free energy, since starch will produce energy on oxidation, and would be impossible unless there were at the same time a compensating degradation of energy.

All living things live and act by utilising the free energy of their environment; the living cell, in fact, acts as an energy transformer. Thus some nitrifying bacteria oxidise ammonia to nitrous or nitric acid and so obtain the necessary energy to build up carbonic acid to sugar or protein; other microbes utilise the free energy of sulphuretted hydrogen and oxygen. Up to the present, all the energy transformations of the living cell so far investigated have been found to obey the second law of thermodynamics, so that all activity depends on the nature and amount of the free energy in the immediate environment, and this applies both to the organism as a whole as well as to its individual cells. If the blood-flow to the brain is stopped, the nerve cells soon cease to function and consciousness is lost; if the entry of oxygen into the lungs is prevented, all the cells of the body sooner or later cease to live.

In the investigation of living phenomena, it is essential to reduce the problems to their simplest terms and study each under controlled conditions; but it must not be forgotten that every action of a cell within the body has its repercussions upon the action of some other cell or cells, so that, having studied a series of isolated phenomena, it is necessary to find the influence each exerts upon the others, to synthesise the parts again into the whole. It is by the application of the laws and facts of physics and chemistry to the elementary phenomena that we are gradually arriving at an understanding of the whole. Whether these laws will suffice to describe all the phenomena or whether a new form of energy will be discovered, none can say.

Among living phenomena recently analysed, those of muscular contraction and the equilibrium between the red blood cells and the plasma are especially noteworthy. The energy of work is obtained from the rapid exothermic conversion of glycogen into lactic acid; when the contraction is over, the glycogen, the muscle's store of free energy, is replaced by the reconversion of the major part of the lactic acid into the polysaccharide, the necessary energy being obtained from the oxidation of the remainder. A balance sheet of the energy changes can be constructed, and it is found that the whole process obeys the known laws of physics and chemistry; that the heat given out or energy absorbed is the same as in the corresponding changes carried out in the test-tube; that there is no loss or gain of total energy. The equilibrium between the red blood cells and the plasma illustrates how one change in a system may set in motion a whole series of changes designed to compensate for the first and bring the system back again to its unstable equilibrium; the whole series of changes can be written in a set of precise mathematical equations; the effects of a given change can be calculated and, when examined experimentally, found to agree with those predicted. Thus each event depends on some preceding event, and the whole series follows exact laws; so far, no phenomena have been found to follow the laws of probability, though this is not to say that such may not be discovered in the future; but at present each event follows inexorably in the footsteps of those preceding and depends upon and is conditioned by them.

There is, however, always the possibility that events occurring in communities of cells such as compose one of the higher organisms, may not be really analogous to those taking place within a single cell, or that the laws governing the phenomena of the large molecules of which the cell protoplasm is composed may not apply to the behaviour of simple molecules, or atoms, or electrons. Sometimes it has appeared as though the movements of the latter might be due to chance rather than to some preceding event occurring in the neighbourhood; but even in the case of such phenomena it is sometimes possible, by application of the laws of chance, to predict the probability, or otherwise, of some future occurrence. It must also always be remembered that what appears to us a chance event may in fact be the sequence of some one preceding, although owing to our ignorance of the phenomena and our inability to repeat the required conditions, appearing to be quite unrelated.

The chief distinction between the inorganic world and life is that in living organisms structure depends on function, and that whereas the structure of the inorganic world may be looked upon as static, the structure of a living cell is dynamic. The cell consists of protoplasm surrounded by a membrane and containing a nucleus: the protoplasmic system of the cell body and nucleus exists in what is known as the colloidal state. Protoplasm has as the basis of its composition protein compounds; but fat-like substances, carbohydrates, salts, and water are also present in the cell. Each living cell acts as an energy transformer; on death it ceases to take up oxygen and other substances from the surrounding medium and to give out energy in one of its various forms. But at the same time it does not simply remain, so to speak, *in statu quo*, like a run-down machine; it disintegrates. In other words, its very structure depends on its being alive, and at the moment of death, this structure begins to fall to pieces; in fact, the cell is destroyed by certain enzymes present in it, which, at death, attack its structure and destroy it.

The reason why these enzymes do not break down the living cell must be because it is alive, and the solution of this problem would go far towards solving the mystery of life itself. It appears that the structure of the cell is chemico-dynamic, and depends on the supply of oxygen for its preservation. Thus the machine of a cell is totally unlike an inorganic machine, which is not destroyed, but simply fails to run, when the supply of fuel gives out. The equilibrium between the cell and its surroundings is thus not static but dynamic; death leads to an irreversible breakdown of structure and the final production of a static equilibrium. In this dynamic equilibrium lies the power of the cell to react and adapt itself to changes in its environment.

At the moment, such investigations throw little light on the origin of life upon this planet, but they do suggest that further research may bring us nearer to a solution of this problem. Astronomy teaches that the earth, thrown off like the other planets of our solar system from the sun under the gravitational pull of a passing star, and held by the sun's attraction in a revolving orbit, cooled down and finally acquired a solid crust, probably at least a thousand million years ago. Since then the water vapour in its atmosphere condensed to form seas and lakes and rivers, and living beings, plant and animal, appeared. Did spores of life, scattered through the universe, reach this planet accidentally, or did life arise from inorganic matter already present on the earth's surface? The theory of 'Panspermia,' besides having to surmount many apparently insuperable obstacles, shuts the doors to all investigation of life's origin; on the other hand, if life arose upon the earth, it is permissible to speculate upon the conditions necessary for its appearance and upon the form or forms it first assumed.

From the fact that the nature and amounts of the inorganic salts in the tissue fluids reflect almost certainly the composition of the oceans a hundred million years ago, it appears justifiable to assume that life arose in the waters of this period of the earth's history. It is probable that the atmosphere at this time contained carbon dioxide and ammonia or sulphuretted hydrogen, so that certain bacteria could have flourished as they do to-day. But whence came the organic matter, the protoplasm, of their cell bodies? Now it has been shown that in the presence of light, moisture, and carbon dioxide, formaldehyde and sugar can be produced at the surface of certain inorganic compounds, such as nickel carbonate, so that it is easy to imagine how certain organic substances might have been produced from inorganic; and similar syntheses of other organic compounds may be found in the future when science discovers the necessary conditions. A further obstacle, however, now requires surmounting: the protein components of the protoplasmic system are optically active, and so far no asymmetric synthesis has been carried out in the laboratory, starting from symmetrical, optically inactive substances. Even when this difficulty is surmounted, as no doubt it will be in the future, the conditions necessary for the production of the complicated structure of the dynamic living protoplasm will have to be obtained.

It is always possible that the origin of life was an exceedingly rare fluctuation from the average of happenings in which organic material arose from inorganic, or structured organic from the structureless. The minute organisms of the filter-passing viruses are of the same order of size as many non-living colloidal particles, so that on the score of size there is no insuperable difficulty in the way of postulating some such origin for living beings. By patient investigation man will delve deeper and deeper into the heart of the mystery of life, possibly forging new tools of technique and reasoning in the process, but whether he will obtain such control of the conditions as to be able to see life arise from the non-living, or whether even it is possible to attain the necessary conditions in the world as we know it to-day, must be left to the future to decide.

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.*]

An Attempt to Accelerate the Rate of Radioactive Transformation.

Danysz and Wertenstein showed in 1915 (*Comptes rendus*, **161**, 784; 1915) that when uranium oxide is bombarded by the α-rays of radium, not one in five million α-particles is effective in changing an atom of U into an atom of UX_1. If we consider that with a layer of uranium containing 1 mgm. per cm.^{2} one α-particle in 20,000 penetrates to a distance less than 5×10^{-12} cm. from the nucleus, and that the emission of an α-particle from uranium seems to start at a distance greater than 5×10^{-12} cm., it is surprising that the unstable radioactive atom shows itself so stable.

According to a theory put forward by Sir Ernest Rutherford (*Phil. Mag.*, Sept. 1927) the α-particles circulate round the nucleus as neutralised satellites. If external action brings about an α-transformation, this action must lead to the artificial break up of an α-satellite. Such a break up must take place in a spontaneous α-disintegration, but while in this case the two electrons go to the nucleus, the violent commotion in the artificial disintegration may lead to the escape of the electrons. If this really happens, a favourable collision of an α-particle with a radioactive nucleus may result in a triple (one + two β) transformation. This assumption would explain the negative results of the former work, for in the case of uranium bombarded with α-rays, a favourable encounter would result in the formation of an atom of U II and not of UX_1, as was previously assumed.

On account of the long period of U II the effect could not be detected unless there were an abundant formation of atoms.

In the case of thorium, however, the product formed after one α- and two β-transformations would be radiothorium with a period of only 2·02 years, and calculation shows that the limit of sensitivity in detecting the change Th–RaTh is about the same as for U–UX_1.

We therefore repeated Danysz and Wertenstein's experiment, substituting thorium for uranium, and we tried to detect changes in α-ray, and not β-ray, activity. We prepared three sources, each containing about 1 mgm. ThO_2 in a uniform layer 3 mm. × 7 mm. Such a layer is equivalent in absorption of α-rays to about 1 cm. air. The sources were covered with thin aluminium leaf to avoid loss of activity by escape of emanation, an effect which was, however, found to be negligible. Their α-ray activity was tested in a differential α-ray ionisation chamber connected with a Wilson electroscope. A difference of activity corresponding to 1/10 mgm. ThO_2 could easily be measured. One of the sources was used as a standard, the others were exposed for six days to the α-rays of radon. They were placed one on either side of a thin-walled glass tube (equivalent stopping power 1·5 cm.), containing initially 28 millicurie of radon. Each source received nearly half the total α-emission. After six days the sources were each compared with the standard. Within 2 per cent no change in activity could be detected.

The number of α-particles from radon and products which fell on each source during the time was $2{\cdot}2 \times 10^{14}$. 1 mgm. thorium with its products gives 27 α-particles per second, and 1/20 of this could be detected, so that if any radiothorium were produced by the bombardment, it gave less than 1·35 α-particles per second. For radiothorium, the disintegration constant $\lambda = \frac{1}{9{\cdot}2 \times 10^7}$ sec.$^{-1}$, and then follow five α-ray products of short life, so that the number of atoms of radiothorium corresponding to 1·35 α-particles per second is $\frac{1{\cdot}35}{5} \times 9{\cdot}2 \times 10^7 = 2{\cdot}5 \times 10^7$.

It appears that the upper limit of the probability of an α-ray collision producing an explosion of this type in the α-satellite is $\frac{2{\cdot}5 \times 10^7}{2{\cdot}2 \times 10^{14}}$; less than one in eight million.

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The Recognition of a New Category of Structures in Spermatogenesis.

In connexion with some work which Dr. Sylvia Wigoder and I are carrying out, it became necessary to re-examine the spermatogenesis of *Cavia*. By chilling the Da Fano fluid (5° C.) it was possible to get extremely good and unshrunken preparations. These revealed a remarkable argentophile band on the ripe sperms (Fig. 1, PNB), which was easily traced back into the sper-

Fig. 1.

matid (Fig. 2, No. 13, PNG) in the form of a group of granules, which constituted in the later spermatid (Fig. 2, No. 14) a sort of coalescing network embracing the hinder part of the nucleus. This reminded me of similar structures already described in *Saccocirrus* (*Q.J.M.S.*, 1922, and Fig. 2, Nos. 1 and 2, PNB) and in a number of pulmonate mollusca (*ibid.*, 1919, and Fig. 2, Nos. 3 and 4, PNG, post-nuclear granules).

The finding of such undoubtedly homologous structures in an annelid, molluscs, and a mammal, made it likely that the post-nuclear system was universal in flagellate spermatogenesis, and the papers of Bowen have been consulted. It is impossible here to enter into all the work of Bowen, but in the pentatomid, *Murgantia* (Fig. 2, Nos. 5 and 6, PNB), Bowen has given a practically correct account of the post-nuclear system (his 'pseudo-blepharoplast'). In probably a number of cases Bowen has mistaken the post-nuclear body for a centrosome or middle-piece. In the urodele (Fig. 2, Nos. 7, 8, and 9), for example, it seems likely that the 'middle-piece' of Meves and Bowen (PNG) is the post-nuclear apparatus. In *Cicindela*, the post-nuclear band, Bowen's chromatinic 'chromatic plate,' is very clear (Fig. 2, No. 10). The most interesting case among Bowen's forms is *Lepisma* (Fig. 2, Nos. 11 and 12). In the stage of Fig. 2, No. 12, Bowen calls the acrosome (A) a 'centrosome,' and the post-nuclear body (PNG) the 'acrosome,' and on the strength of this error refers to the *Lepisma* sperm as an 'atypical flagellate type' (*Jour. Morph.*, 1924; *Anat. Record*, 1925). No other sperm is known which has a centrosome at its tip, and I am quite certain that

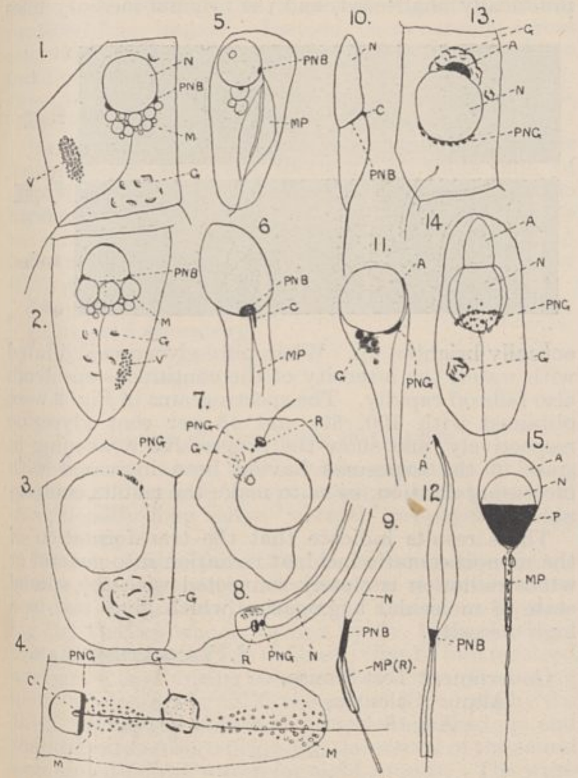

FIG. 2.—A, acrosome. C, centrosome. G, Golgi apparatus. M, MP, middle-piece or mitochondria. N, nucleus. P, PNB, PNG, post-nuclear system. R, ring centrosome. V, vacuolar system. 1, 2, *Saccocirrus*; 3, 4, pulmonate molluscs; 5, 6, *Murgantia*, bug (Bowen); 7, 8, 9, amphibian (Bowen); 10, *Cicindela*, beetle (Bowen); 11, 12, *Lepisma*, silver fish (Bowen); 13, 14, 15, *Cavia*.

Bowen is wrong in his interpretation. In fact, examination of Bowen's figs. 92-118 of his paper in the *Journal of Morphology*, will show that the *Lepisma* spermatid is not abnormal.

Summarising these results, it may be stated that the nucleus of the ripe flagellate spermatozoon is attached to the centrosome and middle-piece by a special structure which I call the *post-nuclear body*. This often forms a flattened cup, in which the hinder part of the nucleus fits, as in mammals like *Cavia*. Post-nuclear bodies are known in annelids, molluscs, insects, amphibians, and mammals, and have been consistently confused with centrosome or middle-piece by various cytologists, and even with the acrosome, as in *Lepisma* (Bowen).

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Sept. 10.

Interpretation of the Atmospheric Oxygen Bands; Electronic Levels of the Oxygen Molecule.

THE known spectrum of the neutral oxygen molecule consists of two well-known band systems, both of which occur in absorption, and arise from the normal state of the molecule. One of these systems, known as the Schumann bands (also known in emission as the Runge bands), lies in the ultra-violet near λ1800, and corresponds to a very intense absorption. The other, known as the atmospheric absorption bands, lies at the long wave-length end of the visible solar spectrum; it is only moderately absorbed in the whole thickness of the earth's atmosphere, and this very weak absorption shows that the upper electronic state of these bands must be classed as a metastable level.

As I have pointed out elsewhere (*Phys. Rev.*, **32**, 213; 1928), the Schumann-Runge bands almost certainly correspond to a $^3S \rightarrow {}^3S$ transition. The structure of the atmospheric bands has been studied by many investigators, but no satisfactory interpretation of the observed structure has been given. In a forthcoming paper in the *Physical Review* I shall, however, show that the structure, with the exception of certain exceedingly weak series (A' band), can be completely explained if the upper electron level is a ^1S level.

In a recent paper (*l.c.*) I have made tentative assignments of electron configurations for a number of diatomic molecules. For the ^3S normal state of the oxygen molecule the configuration assigned is $(1s^s)^2\ (2s^p)^2\ (2s^s)^2\ (3s^p)^2\ (2p^p)^4\ (3s^s)^2\ (3p^p)^2$; the meaning of the symbols is explained in the article cited. As is shown there, this same configuration should also give rise to a ^1S and a ^1D state.

These three states ^3S, ^1D, ^1S may be compared with the three states ^3P, ^1D, and ^1S expected for a carbon atom with the configuration $(1s)^2\ (2s)^2\ (2p)^2$, or an oxygen atom $(1s)^2\ (2s)^2\ (2p)^4$. The analogy is, however, by no means so close as the symbols suggest, since, for the atom, S, P, D refer to the quantum number l, but for the molecule, to σ_l. Nevertheless it probably holds for the following points: (1) one expects the molecular levels ^3S, ^1D, ^1S to lie in an energy range of a few volts, the energy increasing in the order given, as for the atomic levels ^3P, ^1D, ^1S; (2) the two upper levels ^1D and ^1S of the molecule should be metastable like the analogous levels of the atom, and for similar reasons.

It now seems reasonable to identify the upper, ^1S, level of the atmospheric oxygen bands, lying at 1·62 volts above the ^3S normal level, with the *predicted* ^1S level. The exceedingly low absorption coefficient for the transition $^3S \rightarrow {}^1S$—much lower than can be completely accounted for by the fact that this is an inter-system transition—is in agreement with the expected metastability of the ^1S level. Also the interval between the ^3S and ^1S levels is of about the expected magnitude.

If the above explanation is correct, we may expect to find a ^1D level of O_2 between the ^3S and ^1S levels, and may perhaps be able to find a new system of atmospheric absorption bands in the infra-red corresponding to the transition $^3S \rightarrow {}^1D$.

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The Dissociation Energy of Nitrogen.

IN a recent very interesting letter to NATURE (Sept. 1, p. 313) E. Gaviola reports the occurrence of the NH-band λ3360-70, using Wood's arrangement for the optical excitation of mercury vapour, when nitrogen and hydrogen are admitted. From the fact that the intensity of the band is proportional to the square of the intensity of the exciting light, Gaviola concludes that the atomic nitrogen is formed by three-body collisions of N_2-molecules with two excited mercury atoms. It follows that the dissociation energy of nitrogen is less than 9·8 volts, whereas Sponer (*Zeits. f. Phys.*, 34, 622; 1925), according to her interpretation of the nitrogen afterglow, has calculated the value 11·4 volts. Moreover, the latter value is confirmed by a rough extrapolation of the curve for the frequency of vibration in the normal state of the nitrogen molecule (cf. H. Sponer, *Zeits. f. Phys.*, **41**, 611; 1927).

In this connexion it is perhaps interesting to note that a dissociation energy in accordance with Gaviola's experiments results also from the following considerations: in a recent paper "On the structure of the negative nitrogen bands" (*Ann. d. Phys.*, **86**, 189; 1928), I was able to extend this band system considerably; in consequence of which it was possible to extrapolate the curve of the vibration frequency much more accurately than was possible before. The value for the heat of dissociation from the normal state of the molecular ion which results according to the method of Birge and Sponer (cf. *Phys. Rev.*, **28**, 259; 1926) is the same as that derived by Birge and Sponer themselves, namely, 9·1 volts. The value for the dissociation energy from the excited state, however, is found to be 3·7 volts. This, added to the electronic excitation energy of the excited state (3·2 volts), gives 6·9 volts. It is very remarkable that this value is definitely less than the former (cf., *l.c.*). Therefore it is necessary to suppose that the result of a dissociation in the electronic excited state is a normal atom and a normal atomic ion. If, now, according to the formula

$$I_m + D' = D + I_a,$$

where now $D' = 6{\cdot}9$, $I_m = 16{\cdot}7$, $I_a = 14{\cdot}5$ (cf. Birge and Sponer, *l.c.*), the dissociation energy of the normal molecule is calculated, there results 9·1 volts, whereas with 9·1 volts as dissociation energy of the molecular ion ($D' = 7$) the value 11·3 volts which Birge and Sponer have adopted is obtained for D. The former value is quite in accord with Gaviola's observations. Moreover, this value also follows from experimental facts unless it is supposed that the ω-curves, a considerable part of which are now known, show an anomalous behaviour beyond the observed part.

If it should prove true, as is made very probable by the above, that the dissociation energy of the neutral nitrogen molecule is about 9 volts, the interpretation of the afterglow by Sponer should of course be altered, perhaps in the way proposed in a recent letter to Nature (June 9, p. 906) by J. Kaplan and G. Cario. In any case, nitrogen atoms play a predominating part in the production of the afterglow, as I have shown in a recent paper (*Zeits. f. Phys.*, **49**, 512; 1928).

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The Raman Effect in Highly Viscous Liquids.

In his address describing the fundamental discovery of a new type of secondary radiation (*Indian Journal of Physics*, Mar. 31, 1928), Prof. Raman emphasised that the change of wave-length in light-scattering is observed not only in the cases of vapours and liquids, but also in crystals and amorphous solids; a block of ice, for example, showing the shifted lines in the scattered spectrum in approximately the same positions as liquid water. Glasses, on the other hand, show broad bands and not sharp lines. With the view of elucidating the influence of the state of molecular aggregation on the Raman effect, I have made a series of observations of the scattering of the light of the mercury arc in pure dry glycerine at various temperatures, and in glycerine–water mixtures of various strengths.

The results are extremely interesting. The continuous spectrum which accompanies the sharp lines produced by scattering even in such mobile liquids as benzene (Raman, Nature, April 21) is extremely prominent in glycerine. Fig. 1 shows the effect with the 4358·3 A. group as the exciting radiation, a number of more or less diffuse lines or bands being seen overlaid by a strong continuous spectrum. When the glycerine is heated to 120° C., the continuous spectrum becomes weak, while the new lines and bands remain practically unaffected, and the original mercury lines

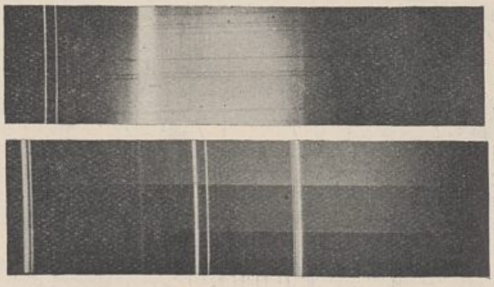

Fig I

Fig II

100%

80%

48%

actually brighten up. When pure glycerine is diluted with water, the intensity of the continuous spectrum also falls off rapidly. The spectrograms in Fig. 2 were obtained with 100, 80, and 48 per cent glycerine respectively, and show the progressive weakening in spite of the exposures having been increased with increasing dilution, so as to make the results comparable.

These results indicate that the transformation of the monochromatic incident radiation into general or white radiation is closely connected with the special state of molecular aggregation which gives rise to a high viscosity.

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Aug. 8.

Wave-length Shifts in Scattered Light.

It seems still uncertain that the modified lines observed by Prof. C. V. Raman in the light scattered by liquids are of the incoherent type of radiation.

Raman has observed that when the ordinary scattering of carbon dioxide brightened up as a cloud was formed near the critical state, the modified scattering increased in intensity also. This appears to indicate coherence in the modified radiation.

I have recently photographed the spectrum of the light scattered by a mixture of phenol and water just above the critical solution temperature and illuminated by a glass mercury lamp. The ordinary scattering here is very intense, so that the mercury lines in the scattered spectrum are very black and very much widened out by over-exposure; yet no trace of the modified lines appears. With benzene, on the other hand, I have found the modified lines showing clearly on a plate much less exposed for the ordinary lines.

It seems, then, that in the case of the phenol–water mixture, the intensity of the modified scattering does not increase with that of the ordinary scattering as the critical state is approached. This would be true if the modified scattering were incoherent as anticipated by the theory of Kramers and Heisenberg.

The failure of Lord Rayleigh and Cabannes to discover the modified lines in their careful study of gases seems to suggest that in the scattered spectra of gases the modified lines are relatively less bright than in those of liquids. This also would be the case on the assumption of incoherence.

A further observation may be of interest. Raman remarks on the peculiar polarised 'fluorescence' of glycerine. Prof. J. C. McLennan has very kindly placed at my disposal a large Hilger spectrograph for the study of the light scattered by glycerine. The mercury lines comprising the ordinary scattering show very clearly in the region studied (from about 3200 A. to 5800 A. on a nine-inch plate), but no modified lines appear. Instead, there extends across the whole region photographed a single fluorescent band which is quite continuous even at the considerable dispersion afforded by this instrument. This 'fluorescent' band is partially polarised.

Raman has found similar though much narrower bands in the scattered spectrum of water and of methyl alcohol. The presence of such a very wide band in the spectrum of glycerine lends support to the inference that the broadening out of the modified lines to bands is associated with the presence of the (OH) group in the formula.

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Aug 20.

Range of Audibility of Gunfire.

AT a time when considerable attention is being given to 'abnormal' propagation of sound, cases of exceptionally long range 'normal' propagation may be of interest.

On July 4, at about 1.23 P.M., a sound like distant gunfire, accompanied by a feeble rattle of windows, was heard at my house in Hythe, and I found on telephoning Dr. Tucker (who is warned by Dr. Whipple about firing practice at the Isle of Grain) that he had received a telegram announcing firing at this time. On tuning in my wireless set to 5XX, the signals broadcast by the B.B.C. giving the instant of firing were picked up, and the intervals between firing and the arrival of the sound were timed by my watch for eight rounds. The wireless signals ceased at about 2.0 P.M. but the gun was heard for at least half an hour longer, at roughly four-minute intervals.

The time of travel of the sound was 2 min. 33 sec. for two rounds, which were both described at the time as heard very feebly but distinctly indoors; 2 min. 34 sec. for five rounds, which were variously described as 'scarcely audible' to 'quite loud, shaking window,' and 2 min. 35 sec. for one round which was heard loudly.

The distance from my position to the gun was 168,750 feet, and the average time of travel was 2 min. 33·9 sec., giving a velocity of 1096 feet per second. The bearing of my position from the gun was 148° to the nearest degree.

The gun was again heard by several observers near Lympne and at Newchurch several miles farther west, on Aug. 2. At Lympne it was only heard with close attention in a sheltered position outdoors, but at Newchurch it was heard more plainly. The distances from the gun were 166,600 feet and 163,150 feet respectively. Timing was done at Lympne by chronometers ticking half seconds and at Newchurch by $\frac{1}{5}$th second stop watches. The average time for six rounds at Newchurch was 147·3 sec., giving a velocity of 1107·7 feet per second. The average time for four rounds at Lympne was 150·4 sec., giving a velocity of 1107·6 feet per second. The bearing of Lympne from the gun was 150° and the bearing of Newchurch was 160° to the nearest degree.

From a casual inspection of meteorological data for these days, it would appear that the path of the sound was much more direct on Aug. 2 than on July 4.

P. ROTHWELL.

Air Defence Experimental Establishment,
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Westerham, Kent, Sept. 6.

Photographic Enlargement of Small Solid Objects.

IN NATURE of Aug. 18, p. 239, Mr. A. Mallock makes the admirable suggestion that the required magnification should be obtained, not directly, but by ordinary enlargement from a negative showing the object on some lower scale—the intermediate negative being of course taken to such a standard of sharpness as will permit of the subsequent enlargement. This seems to be the only way by which the great difficulties of this kind of work can be overcome. The most troublesome business of all is that of focusing, and this could be entirely eliminated if a simple form of enlarging camera were carefully and permanently registered to give perfect focus on some one fixed intermediate scale, and means were provided for measuring exactly the depth of the object about to be photographed, and for putting the object in its proper position in front of the lens.

In the *British Journal of Photography* of Oct. 30 and Nov. 6 and 13, 1925, under the heading "Low Magnification Photography," I endeavoured to write something useful on this subject, and I was thrown back on the method now suggested as the only practicable one. For higher magnifications, the apparatus was registered to give a direct three diameter negative, while for magnifications from one to three diameters, it was registered to give natural size. A very sensitive 'focus register' was described which served the double purpose of measuring the photographic depth of the object and placing it in position.

It is a pity that Mr. Mallock has deserted the usual method of defining the sharpness of a photograph by the diameter of the blurs or confusion circles on the negative which represent points on the object, as nothing seems to be gained by the change and his argument is not easy to follow. The example he has chosen—a twenty diameter enlargement of a tenth of an inch depth of object—is also very extreme and scarcely practicable, at least with a 0·1 inch stop. The resulting blurs in this case, as shown by his very useful formulæ, would be 0·02 inches in diameter, or twice that allowed by the lowest accepted standard of sharpness.

The extent to which magnification can be carried out will depend upon the smallness of the stops that can be used without introducing diffraction and other troubles. For this and other technical reasons I was compelled to draw the line at a maximum of magnification of ten diameters. But between one and ten diameters or less, an immense variety of useful and interesting work for the photographic illustration of books lies waiting to be done.

H. C. BROWNE.

Dublin, Sept. 6.

Can the Hand be thrust in Molten Lead without Injury?

In reply to Mr. A. S. E. Ackermann's inquiry in NATURE, Sept. 8, p. 349: Some thirty years ago I gave a popular lecture on "Flat Irons and the Spheroidal State" at Birkbeck College, at the end of which I illustrated the ancient ordeal of fire by plunging my hand—up to the wrist—into about 80 lb. of molten lead. The lead must be hot—that is the secret.

F. CHESHIRE.

23 Carson Road,
Dulwich, S.E.21.

The Influence of Engineering on Civilisation.[1]

By Sir William Ellis, G.B.E.

Engineering in its many branches has taken, and is still taking, a very extensive part in connexion with the amenities which are associated so closely with our domestic life, and indeed our happiness. Each branch of engineering has added its quota to the comfort of our lives, and I think it may be claimed that no other profession has so direct an association with our modern civilisation. The enormous increase in population during the nineteenth century, coupled with the segregation of that population in industrial centres, arising out of the extraordinarily rapid development of industry in Great Britain and other countries during that period, has introduced new problems in connexion with health and transport, and it has been the task of engineering in its many branches to deal with these problems.

The introduction of railways and of steamers during the first half of that century led the way to an enormously increased demand for coal, iron, and steel, and as the inventions of Sir Henry Bessemer and Sir William Siemens for making steel were developed, the necessity was evident to engineers and chemists for training schools to deal with the physical and technical problems involved in engineering and metallurgy, so as to arrive at a far greater accuracy, both in design and construction, than had hitherto been considered necessary or possible.

We have to admit, however, that the progress of industry depends very largely on the enterprise of deep-thinking men who are ahead of the times in their ideas. I may quote Dr. Clifton Sorby as such an instance. He introduced by his researches the microscopy of steel, and yet it was many years before this became a recognised method of gauging the quality of all classes of steel. Another great inventor, whom we all respect and are delighted to have still in active work, is Sir Charles Parsons, and I look back many years to the early 'eighties when Sir Charles put in years of research work in connexion with high speed engines before he successfully produced the steam turbine. Since that time he has devoted a large portion of his life to developing improvements both in the design of the turbine and the machinery for producing it, which have ultimately brought about its world renown.

Civil Engineering.

The point which appears to me to stand out prominently in this branch of the profession is the fact that the structures to be dealt with are in many cases of an enormously costly nature, and have to be carried out with such careful study and comprehension of the varying problems to be dealt with so as to ensure permanent efficiency and safety in the future.

The great reservoirs and harbours of the world may be regarded as the cathedrals of engineering. The varying natural problems to be dealt with involve a very high level of technical education. In the construction of reservoirs, docks, and harbours, a considerable knowledge of geology is essential, and in harbour construction the varying effects of tides, which have to be studied minutely, have an important influence on the work to be undertaken. Throughout the world will be found monuments to the skill of the civil engineer, and the very existence of the population in our large cities in health and comfort is the result of his work, for without an ample and reliable supply of water of good quality, both for personal and industrial use, and an efficient drainage control, our death-rate would indeed be very different from what it is. If we turn for a moment either to India, with its great barrage enterprise, or Egypt, with the noble Assuan and Sennaar dams, truly outstanding works of the civil engineer, we find the prosperity of these countries largely resulting from the magnificent irrigation works which have been carried out there. Special development of produce growing in many countries is only being limited by the fact that insufficient irrigation works have so far been carried out. New Mexico and Arizona are two great provinces with potentially fertile land available for agricultural development, but they are so short of water that irrigation is an absolute necessity.

The large increase in tonnage of ocean-going vessels has resulted in the necessity for larger docks and harbour basins, and the development of railways all over the world, many of them in difficult mountainous countries, has given the civil engineer a great opportunity in designing bridges for carrying this heavy traffic. Many will appreciate the magnitude of the new bridge over Sydney Harbour which is now being constructed by British engineers, and the Forth Bridge still holds its own as a masterpiece of British engineering skill and the construction was in the hands of a Scotch firm well known in Glasgow. The new high-level bridge at Newcastle and the new Mersey tunnel are, I suppose, the most interesting civil engineering works at present in progress of construction in Great Britain, in addition to the considerable dock extensions now proceeding at Southampton, whilst in Canada a very noble bridge is now being thrown across the St. Lawrence River at Montreal.

Transport.

It may truthfully be said that the development of the potential wealth of any country depends mainly on the means of transport, both personal and industrial. I would allude especially to the great corn-growing countries where the home consumption bears only a small relation to the possible production. The knowledge that there is efficient transport both by rail and for export by sea is the greatest incentive to the farmers to spend money in extensive cultivation with the certainty of a ready market for such production.

[1] From the presidential address to Section G (Engineering) of the British Association, delivered at Glasgow on Sept. 7.

The comparison of travel to-day, both by land and sea, with my early journeys in Europe nearly fifty years ago, emphasises in my mind how much we are indebted to the engineer, in the way of personal safety and comfort and also prompt delivery of our products. A journey in the Balkans in the winter of 1881, when sleeping cars and restaurant cars were almost unknown, and when the largest vessel sailing from Mediterranean ports was in the neighbourhood of 4000 tons, compares very unfavourably in speed and personal comfort with the facilities which are available to-day. The comfort and safety of modern travel is to my mind one of the glories of modern civilisation. The 40,000 to 50,000 tons Atlantic liner, embracing as it does almost every class of engineering skill, is not only an example of artistic beauty, but is also one of the finest example of human power combating the forces of Nature. To be on one of these vessels driving into a gale at twenty knots is an experience never to be forgotten, and we are glad to realise what a large share the shipbuilding firms of Glasgow have had in the development of these large Atlantic liners.

Railway transport has also made great progress in all measures affecting personal safety and the efficient carrying of our various products. The railway engineers have every reason to be proud of their management of the complex organisation represented by the great railway systems all over the world. We are personally much safer travelling in an express train than we are crossing the streets of a great city, and I think we may justly be satisfied by the fact that in no country do the railways afford more comfortable or more rapid travelling facilities than in our own.

Naval Architecture.

This comprises shipbuilding and marine engineering and represents a very important part of my subject, dealing, as it does, with the transport by sea and lakes of food and materials, and with the comfort and safety of the many thousands of passengers travelling to and from Great Britain. The wooden vessel in the early part of last century held its own very stubbornly against the introduction of iron or steel vessels, and the mechanically propelled vessel had to fight very hard to oust the very efficient sailing vessels which were then carrying the trade of the world. I imagine that some with artistic tastes will not be willing to admit that the beauty of the present type of machanically propelled vessel is comparable with the picturesque five- and six-mast sailing vessels which we used to see in our earlier days.

Great Britain has undoubtedly been the pioneer in the building of large warships and passenger liners, also in the development of the very large horse-power therefor. The considerable increase in the tonnage of ships brought with it the necessity for a corresponding increase in the mechanical appliances in connexion with their construction. The trial runs carried out before a new ship is taken over by her owners are a severe test of the excellence of workmanship. They are a necessary test to ensure that long voyages of five to six weeks with machinery running continuously at nearly full power can be undertaken without fear of trouble arising from heated bearings or other causes. A new ship may be exposed to such rough weather on her first voyage that, unless her plating and riveting are carried out in a first-rate manner, she may arrive in her first port in a damaged condition. Glasgow has taken a leading part providing men who, in all weathers and under conditions rendered difficult by the magnitude of modern vessels, maintain the high level of efficiency which is represented in the manufacture of these large hulls. The vessels of the greatest tonnage built on the Clyde have been the *Aquitania* (46,000 tons) and the *Lusitania* (32,500 tons). Other large vessels built in the British Isles have been the *Olympic* (46,439 tons) and the *Mauretania* (30,696 tons). Since the War there has been a lull in the building of liners of large tonnage and horse-power, caused, no doubt, by financial considerations.

Shipbuilding is especially interesting inasmuch as it combines in one structure the varied efforts of almost every class of artisan dealing with both iron and steel and cabinet making and woodworking generally, in addition, of course, to the large and varied amount of mechanical engineering. High and low pressure triple expansion engines held their own for a considerable period, and it was, I suppose, the interesting trials of the *Turbinia* which brought about the first change from this method. It is an interesting fact that our fellow-member, Sir Charles Parsons, to whom I have already alluded, should live to see such successful development of his patent, and a recent paper read by him and his co-workers describes in a very interesting manner the gradual developments and changes in design in turbines up to the present time. Such developments range from the *Turbinia*, which had a displacement of 44½ tons with 2100 h.p., to the battle cruiser *Hood* of 41,200 tons and more than 150,000 h.p.

The introduction of geared turbines, so as to arrive at relatively efficient speed as between engine revolutions and propeller revolutions, has brought about valuable economies and helped the turbine principle to maintain its reputation. The development of internal combustion engines for marine purposes has made great strides in recent years. Various types of these engines are already in active service, and a horse-power of 36,000 on four propellers has already been achieved with efficiency; probably the limit has not yet been reached. The use of oil instead of coal on board ship, especially for passenger purposes, represents many advantages, and anyone who has visited the stokehold of a large passenger liner with the hundreds of men stoking with coal must realise the immense advantage, both physical and otherwise, which results from oil burning directly on the boilers. All inconvenience caused by dust in re-coaling is avoided, and the boiler tenting is carried out by young mechanical engineers, doing away with all the labour required by coal burning. In a vessel of large tonnage the saving in wages and maintenance of several hundreds of stokers represents an enormous economy in many directions. The question of larger horse-power and/or electrically driven ships is one of the problems to which marine engineers are at present turning their minds.

A new development which is now being introduced is the use of considerably higher steam pressures in boilers. The first application of this was the *King George V.*, a boat built recently on the Clyde, and our section has been favoured with a paper from Mr. Harold Yarrow dealing with some of the problems which have arisen in introducing high pressures. As will have been gathered from his paper, these problems are not solely those of the engineer who has to build the boilers. They are also closely associated with steel and metallurgical questions incident to the special manufacture of parts of the boilers owing to the much greater strength required.

Mechanical Engineering.

It is difficult to regard mechanical engineering literally as a separate branch of engineering, for although numerically, I suppose, the mechanical engineers exceed the numbers of any other branch, nearly all their duties are associated with other types of engineering.

In connexion with civil engineering, all the plant occupied in harbour, dock, and railway construction is in the hands of the mechanical engineer. Also in transport and marine engineering the mechanical engineer is largely engaged in the engine building of both locomotives and marine engines and other types of auxiliary machinery for these purposes.

In electrical engineering, although this branch no doubt includes engineers without mechanical training, I would venture to say that the engineer is in an infinitely stronger position if he has received some training first as a mechanical engineer and specialised in electrical engineering afterwards.

A further important branch of the mechanical engineer's work is represented by the maintenance of machinery in the large steel works throughout the country and in the mills and factories of all descriptions. The directors of these companies are largely dependent on the advice of the engineer-in-charge in giving consideration to developments and the introduction of new types of plant to maintain production on an economic basis.

In mechanical engineering I must include the very important subject of machine-tool construction, a branch of engineering which has made very great strides and introduced many changes of design to meet new requirements in the last thirty years. Mass production on an economical basis in many industries has been the direct result of various tool-makers being able to produce special tools confined to the production of thousands of identical articles of a complicated design. I refer to articles produced at a cost of one-tenth to one-twentieth of what would be possible without machine tools specially designed for the purpose.

The introduction of high speed tool steel enabling far heavier cuts to be taken both by lathes and planing machines has rendered obsolete a large quantity of machine tools throughout the country, and the introduction of the electric drive has also brought about great changes in the design of machine tools. We hear to-day of some works in other countries without a single machine tool at work of pre-War date, a most desirable state of things, but one which, unhappily, the economic circumstances in Great Britain have rendered impossible up to the present time.

May I make a suggestion to the tool-makers in Great Britain? When we are putting down an important new machine tool I find the makers will give every possible help in meeting our requirements in design and output, but they rarely follow up and ascertain what the real performance of the tool has been. To many of them 'no news is good news.' I think this is a mistake on their part. How many improvements and modifications, probably saving their clients money, could be made if they would periodically send the designer or chief draughtsman round to the works where these machines are actually at work and ascertain at first hand from the foreman and even the workman what criticisms they have to make, and accept for careful consideration any suggestions that may be put forward based on personal knowledge of the output of the machine.

Mining Engineering.

In dealing with this section I propose to confine myself to coal mining, so as to shorten what I have to say, and also to be able to apply myself more closely to the development of coal mining as affecting civilisation.

Prior to the introduction of modern means of transport and the development of the iron and steel trade, the production of coal in Great Britain, both in the aggregate and per colliery, was very small, and consequently the amount of virgin coal face exposed at any one time in a colliery was quite moderate. Therefore the effusion of gas was not sufficiently large as to introduce a serious danger to men working with naked lights. Ventilation was carried out by means of a furnace in the bottom of the upcast shaft, the draught being sufficient for ventilating the moderate area of the workings. Increased production necessitated the adoption of mechanical means of ventilation and large fans were installed. Science had a large share in making colliery development on a big scale possible by the introduction of the Humphry Davy and other safety lamps. These warned the miners of the presence of gas and consequent danger. The much heavier tonnage produced in a given time necessitated the introduction of large horse-power winding engines, and also of wire ropes which would be sufficiently pliable to pass over the pulleys and headgear, and also be strong enough to carry not only their own weight, which in a shaft of 500 yards is not inconsiderable, but, in addition, a loaded cage involving a weight of thirty tons or more.

A sufficient supply of coal at a moderate price is a matter of interest to every inhabitant and manufacturer in the country, and therefore any engineering devices which have been introduced to ensure comfort and safety of the miners, and at the same time to give us our coal supply for manufacturing and domestic purposes at a moderate price, are of interest to everyone. Although we unhappily know that colliery explosions occasionally occur with very dire results, and regret the many accidents to miners arising out of falls of roofs, etc., those of us who are conversant with coal mining matters realise how much science and engineering have done to lessen the risk under which the miners work. Underground haulage has been everywhere adopted, so that the use of men for this arduous work, and, to a great extent, ponies also, has been abandoned. This underground haulage is largely carried out by compressed air engines placed underground, as in many pits it has not been felt safe to introduce electric power for the purpose except in the immediate neighbourhood of the shafts. It is true that the electrical engineer has gone a long way in lessening the liability to sparking, and in enclosing the motors so as further to lessen this risk. We are still left, however, with possible danger caused by the cables along the main roads, which, however carefully placed, are still liable to be damaged by unexpected falls of roof, thereby introducing a potential danger which is difficult to eliminate.

Electrical Engineering.

This branch of engineering covers a very wide range of subjects and affects our social life almost more intimately than any other type of engineering, except perhaps the supply of good water and efficient drainage installations. Telegraphy, telephony, wireless, electric lighting, electric heating, electric driving, and electric power in their various ranges all enter into and affect the comfort of our domestic life. In considering this branch of engineering as a whole, I find it very difficult fairly to divide the credit for its development between the pure scientist and the electrical engineer. It is interesting at this meeting in Glasgow to recall that it was at the British Association meeting in this city in 1876 that Graham Bell, in conjunction with Lord Kelvin, brought to the Association's notice the telephone, and, further, the fact that at the Plymouth meeting of this Association in 1877, I shared with many eminent members of the British Association the interesting privilege of telephoning from the saloon to the bridge on the excursion steamer, with Prof. Graham Bell on board, going to and from the Eddystone Lighthouse. I allude to this fact because in those days it was regarded as a wonderful scientific invention which fascinated the most eminent scientific men. Yet to-day we take it all for granted, and scarcely realise the comfort and convenience that the introduction of the telephone has brought into our lives.

I admit that the introduction of wireless telephony and telegraphy has amazed the world to a greater extent than that of the telephone, and it is certainly more within the capacity of the pure scientist than of the engineer to explain the scientific problems involved. It is impossible to say what number of lives have already been saved by boats in distress having been able to secure help from other vessels by means of wireless communication.

The development of electricity as a mechanical driving power was very slow up to a certain date. For example, I went by electric train from Berlin to Charlottenburg in the spring of 1882. The running of the railway appeared to be quite satisfactory, and yet it was at least ten, and I think fifteen, years before any real development took place in the way of electric railways or trams, the difficulty, I believe, being in producing satisfactory dynamos on an economic basis.

In Great Britain considerable developments are taking place on the various main lines, but engineers are at present concentrating on the use of electric driving mainly for suburban traffic, and not at present on main line long distance expresses. It is probable that the great extension of high power installations throughout the country contemplated by the Electricity Commissioners will render possible a more extensive use of electric trains on our main lines.

The application of electricity for driving purposes in the various large works in Great Britain made very rapid strides as soon as electrical machinery for the purpose was available. Apart from the economy represented by its introduction, the change enabled the management to register the amount of power used by each type of machine under varying loads of service, a circumstance which was impossible with belt-driven machines, when the power varied according to the tightness and width of the belt.

The public, I think, fails to realise that electric lighting for domestic purposes, if charged at a reasonable rate, does not represent any real charge on the household. It is so clean in its application that, in my opinion, the necessity for cleaning and decorating which is avoided in many cases represents a greater saving than the amount paid for electric light. In addition we have the great advantage that it does not burn oxygen, and therefore we have more healthy conditions in our rooms compared with any other method of lighting.

Since I roughed out this address it has been my privilege to make a journey across America from New York to the Pacific Coast, and return through the Rocky Mountains and Canada, and throughout my journey I could not help realising how large a share engineering in its broadest sense has taken in developing these wide regions. Those of us who are spending our lives in engineering work may justly be proud of the large share the members of our profession are taking in promoting and advancing the civilisation of the world.

The Mystery of Life.[1]

By Prof. F. G. DONNAN, C.B.E., F.R.S.

DURING the last forty years the sciences of physics and chemistry have made tremendous strides. The physico-chemical world has been analysed into three components, electrons, protons, and the electro-magnetic field with its streams of radiant energy. Concurrently with these advances astronomy has progressed to an extent undreamed of forty years ago. Amidst the vast cosmos disclosed to the mind of man, our sun winds its modest way, an unimportant star, old in years and approaching death. Once upon a time, so the astronomers tell us, its surface was rippled by the gravitational pull of a passing star, and the ripples becoming waves broke and splashed off. Some drops of this glowing spray, held by the sun's attraction in revolving orbits, cooled down and became the planets of our solar system. Our own planet, the earth, gradually acquired a solid crust. Then the water vapour in its atmosphere began to condense, and produced oceans, lakes, and rivers, as the temperature sank. It is probably at least a thousand million years since the earth acquired a solid crust of rock. During that period living beings, plants and animals, have appeared, and, as the story of the rocks tells us, have developed by degrees from small and lowly ancestors. The last product of this development is the mind of man. What a strange story! On the cool surface of this little planet, warmed by the rays of a declining star, stands the small company of life. One with the green meadows and the flowers, the birds, and the fishes, and the beasts, man with all his kith and kin counts for but an infinitesimal fraction of the surface of the earth, and yet it is the mind of man that has penetrated the cosmos and discovered the distant stars and nebulæ. Truly we may say that life is the great mystery, and the study of life the greatest study of all. The understanding of the phenomena of life will surely be the crowning glory of science, towards which all our present chemical and physical knowledge forms but the preliminary steps.

Observing the apparent freedom, spontaneity, and indeed waywardness of many forms of life, we are at first lost in amazement. Is this thing we call life some strange and magical intruder, some source of lawless and spontaneous action, some fallen angel from an unknown and inconceivable universe? That is indeed the question we have to examine, and we may begin our examination in a general way by inquiring whether living things are subject to the laws of energy that control the mass phenomena of the inanimate world. The first of these laws, known as the law of the conservation of energy, says that work or energy can only be produced at the expense of some other form, and that there are definite rates of equivalence or exchange between the appearing and disappearing forms of energy. In a closed system we can make up a balance sheet and we find that the algebraic sum of the increases and decreases, allowing of course for the fixed rates of exchange, is zero. That was one of the great discoveries of the nineteenth century. The physiologists have found that living beings form no exception to this law. If we put a guinea-pig or a man into a nutrition calorimeter, measure the work and heat produced and the energy values of the food taken in and the materials given out, we find our balance sheet correct. The living being neither destroys nor creates energy.

Another great discovery of the nineteenth century, the so-called second law of thermodynamics, restricts the direction of energy transformations. So far as is known, the facts of biology and physiology seem to show that living beings, just like inanimate things, conform to the second law. They do not live and act in an environment which is in perfect physical and chemical equilibrium. It is the non-equilibrium, the free or available energy of the environment, which is the sole source of their life and activity. As Bayliss so finely put it, equilibrium is death.

The chief source of life and activity on this planet arises from the fact that the cool surface of the earth is constantly bathed in a flood of high temperature light. If radiation in thermal equilibrium with the average temperature of the earth's crust were the only radiant energy present, practically all life as we know it would cease, for then the chlorophyll of the green plants would cease to assimilate carbonic acid and convert it into sugar and starch. The photo-chemical assimilation of the green plant is a fact of supreme importance in the economy of life. This transformation of carbonic acid and water into starch and oxygen represents an increase of free energy, since the starch and oxygen tend naturally to react together and give carbonic acid and water. A living being is not a magical source of free energy or spontaneous action. Its life and activity are ruled and controlled by the amount and nature of the free energy, the physical or chemical non-equilibrium, in its immediate environment, and it lives and acts by virtue of this. The cells of a human brain continue to act because the blood stream brings to them chemical free energy in the form of sugar and oxygen. Stop the stream for a second and consciousness vanishes. Without that sugar and oxygen there could be no thought, no sweet sonnets of a Shakespeare, no joy, and no sorrow.

To say, however, that the tide of life ebbs and flows within the limits fixed by the laws of energy, and that living beings are in this respect no higher and no lower than the dead things around us, is not to resolve the mystery. Growth and development seem to proceed on a definite plan, and apparently purposeful adaptation confronts us at many stages of life. How can the differential equations of physics or the laws of physical

[1] From an Evening Discourse delivered on Sept. 11 at the Glasgow meeting of the British Association.

chemistry attempt to explain or describe such strange and apparently marvellous phenomena ? The answer to this question was given more than fifty years ago by the great French physiologist, Claude Bernard. We must patiently proceed, he said, by the method of general physiology. Its method consists in determining *the elementary condition of the phenomena of life*. We must decompose or analyse the great mass phenomena of life into their elementary unit or constituent phenomena.

To-day general physiology in its application of physics, chemistry, and physical chemistry to the operations of the living cell, is the fundamental science of life. Patiently pursued and step by step it is unravelling the mystery. The future findings of general physiology may be as strange to the investigators of to-day as the relativity theory of Einstein and Minkowsky was to the physicists of a few years ago ; yet they will be continuous and homologous with the science of to-day. Should, indeed, a new form of energy, ' a special nervous energy,' be discovered, as predicted by the eminent Italian philosopher, Eugenio Rignano, it will be no twilight will-o'-the-wisp, no elusive entelechy or shadowy vital impulse, but an addition to our knowledge of a character permitting of exact measurement and of exact expression by means of mathematical equations.

The chemistry and energy changes of muscle have been discovered recently by Meyerhof in Germany and by A. V. Hill and others in England. When the muscle tissue contracts and does work, it derives the necessary free energy, not from oxidation, which is not quick enough, but from the rapid exothermic conversion of the carbohydrate glycogen into lactic acid. When the fatigued muscle recovers, it recharges its store of free energy ; that is to say, by oxidising or burning some of the carbohydrate, it reconverts the lactic acid into glycogen. Thus in the recovery stage we have the coupled reactions of exothermic oxidation and endothermic conversion of lactic acid into glycogen. Everything proceeds according to the laws of physics and chemistry. Here we see one of the elementary phenomena of life already to a great extent analysed and elucidated.

Another example is what I may call the blood equilibrium. The red blood cells are enclosed in a membrane which does not allow the hæmoglobin to escape, and only permits of the passage of inorganic anions, though water and oxygen can pass freely in and out. Between the red cells and the external blood plasma in which they are submerged there exists a whole series of delicate exchange equilibria, such as water or osmotic equilibrium, ion-distribution equilibria, etc. The entrance of oxygen, which combines with the hæmoglobin, converts it into a stronger acid and ejects carbonic acid from the bicarbonate ions within the cell. Any disturbance of one of these equilibria produces compensating changes in the others. The whole series of equilibria can be written down in a set of precise mathematical equations. Thus two of the most important elementary phenomena of many forms of life, namely, respiration and the exchanges of the red blood cells, have been analysed, subjected to exact measurement, and described by exact mathematical equations.

What is the lesson to be drawn from these examples ? No less than that the elementary phenomena of life are *deterministic* ; that is to say, that events compensate or succeed each other just as in the physico-chemical world of inanimate things, and that their compensations and successions can be exactly measured and expressed in the form of precise mathematical equations. The investigations of general physiology, so far pursued, indicate that the elementary phenomena of life are quite as fully deterministic as phenomena on a corresponding scale of magnitude in the inanimate physico-chemical world.

Let us now make the daring supposition that general physiology, following the lead of Claude Bernard, has eventually succeeded in quantitatively analysing every side and every aspect of the elementary condition of life. Would such a supposedly complete and quantitative analysis give us a synthesis of life ? That is one of the most fundamental and difficult questions of biological science. A living being is a dynamically organised individual, all the parts of which work harmoniously together for the well-being of the whole organism. The whole appears to us as something essentially greater than the sum total of its parts. This aspect of the living individual was fully recognised by Claude Bernard. It has been emphasised recently by General Smuts in his remarkable book on "Holism and Evolution." Life, as seen by General Smuts, is constantly engaged in developing wholes, that is to say, organised individualities. We may indeed learn how the regulative and integrating action of the nervous system, so beautifully and thoroughly investigated by that great physiologist, Sir Charles Sherrington, serves to organise and unite together in a harmonious whole the varied activities of a complex multicellular animal. We may learn, too, how those chemical substances, the hormones, discovered by Bayliss and Starling, are secreted by the ductless glands, and, circulating in the *milieu intérieur* of an animal, act as powerful means for harmoniously regulating and controlling the growth and other activities of the various organs and tissues. Nevertheless, in spite of these great discoveries, the harmonious and dynamic correlation of the various organs and tissues of a living organism ever confronts us as one of the great mysteries of life. In an inanimate physico-chemical system we think, if we know the situations, modes of action and inter-relations of the component parts, whether particles or waves (or both), together with the boundary conditions of the system, that we have effected a complete synthesis of the whole. Though very crudely expressed, some such view as that lies at the basis of the Newtonian philosophy which rules our thought in the inanimate physico-chemical world.

Leibnitz once remarked that "the machines of nature, that is to say, living bodies, are still machines in their smallest parts *ad infinitum.*" Anatomy and histology have progressively disclosed the structure of living things. Histology has revealed to us the cell with its nucleus and cytoplasm as the apparently fundamental unit of all organs and tissues of a living being. What is contained within the membrane of a living cell? Here we approach the inner citadel of the mystery of life. If we can analyse and understand this, the first great problem—perhaps the only real problem — of general physiology will have been solved. The study of the nature and behaviour of the living cell and of unicellular organisms is the true task of biology to-day.

The living cell contains a system known as protoplasm, though as yet no one can define what protoplasm is. One of the fundamental components of this system is the class of chemical substance known as protein, and each type of cell in each species of organism contains one or more proteins which are peculiar to it. Strange to say, the living cell contains within itself the seeds of death, namely, those so-called autolytic enzymes which are capable of hydrolysing and breaking down the protein components of the protoplasm. So long, however, as the cell continues to live, these autolytic enzymes do not act. What a strange thing! The harpies of death sleep in every unit of our living bodies, but as long as life is there their wings are bound and their devouring mouths are closed.

It appears from A. V. Hill's work on non-medullated nerve cells and on muscle that the organised structure of these cells is a *chemo-dynamic* structure which requires oxygen, and therefore oxidation, to preserve it. The organisation, the molecular structure, is always tending to run down, to approach biochemical chaos and disorganisation. It requires constant oxidation to preserve the peculiar organisation or organised molecular structure of a living cell. The life machine is therefore totally unlike our ordinary mechanical machines. Its structure and organisation are not static. They are in reality dynamic equilibria, which depend on oxidation for their very existence. The living cell is like a battery which is constantly running down and requires constant oxidation to keep it charged.

The last great problem which I shall venture to consider in this brief sketch concerns the origin of life. If the living has arisen on this planet from what we regard as the non-living, then various extremely interesting points arise. It is already fairly certain that it originated, if at all, in the primeval ocean, since the inorganic salts present in the circulating fluids of animals correspond in nature and relative amounts to what we have good reason to believe was the composition of the ocean some hundred million years ago. The image of Aphrodite rising from the sea is therefore not without scientific justification. The question arises as to how organic substances could have arisen by degrees in a primeval ocean originally containing only inorganic constituents? The late Prof. Benjamin Moore took up this subject and endeavoured to prove that colloidal iron oxide, in the presence of light, moisture, and carbon dioxide could produce formaldehyde, a substance from which sugar can be derived. This work of Moore's has been actively taken up and developed by Prof. Baly in recent years. He has conclusively proved that, in the presence of light, moisture, and carbon dioxide, formaldehyde and sugar can be produced at the surface of certain coloured inorganic compounds, such as nickel carbonate. We may therefore conclude that the production of the necessary organic substances in the primeval ocean offers no insuperable obstacle to science.

The sincere and honest men who are advancing science, whether in the region of life or death, are those who measure accurately, reason logically, and express the results of their measurements in precise mathematical form. A hundred or a thousand years from now mathematics may have developed far beyond the extremest point of our present-day concepts. The technique of experimental science at that future date may be something undreamed of at the present time. But the advance will be continuous, conformal, and homologous with the thought and reasoning of to-day. The mystery of life will still remain. The facts and theories of science are more mysterious at the present time than they were in the days of Aristotle. Science, truly understood, is not the death, but the birth, of mystery, awe, and reverence.

Obituary.

ROALD AMUNDSEN.

HAD Ibsen lived to write the Saga of Roald Amundsen, he might have analysed the emotions which surged through the explorer's soul in a tempest of ambition, triumph, and tragedy. The dramatic episodes of the adventurous life seem to demand a psychological nexus more likely to be found in philosophy than in science, and only capable of full expression in poetry.

Roald Amundsen was born at Borgo in the south of Norway on July 16, 1872; he lived in Oslo from his infancy, going through the ordinary Norwegian educational course. His father, who was a shipowner, died when the boy was fourteen years of age, and his mother, being desirous of seeing him in the medical profession, induced him reluctantly to begin the preliminary studies at the University of Oslo. Since as a boy of fifteen he had been enthralled by the story of Sir John Franklin, he had secretly set his heart on becoming a polar explorer, and to fit himself for the life he took every opportunity of exercising himself in ski-running, and slept with open windows throughout the Norwegian winters. His first journey in Arctic conditions very nearly proved his last adventure in exploration. In the Christmas holidays of 1892 he started with a companion to cross the Norwegian plateau from a farm-house near Oslo to one near Bergen, an uninhabited stretch of 72 miles, with no possibility of reaching Bergen if the house which marked the only practicable descent from the plateau were missed. It was missed, and after several days without any shelter but their sleeping bags their provisions failed, and when at last they struggled back to the eastward they had been four days without food. In none of his serious expeditions did Amundsen suffer more from cold and starvation.

On the death of his mother Amundsen dropped the hated medical classes and proceeded to qualify as a sailor, for he had decided that polar explorers who were not sailors were entirely at the mercy of the commanders of their ships. He served for several summers as a seaman on an Arctic ship and, studying in the intervals of the voyages, he speedily obtained his mate's certificate. When de Gerlache prepared his heroic adventure in the *Belgica* in 1897, Amundsen secured the position of first mate and rejoiced in the company of such nimble-witted and enthusiastic colleagues as Lecointe, Arctowski, and F. A. Cook. The *Belgica*, after wasting precious time in Tierra del Fuego, proceeded through the South Shetland Islands and along Graham Land until late in the season by a blunder, which Amundsen recognised but was not allowed to avoid; she was caught in the ice and drifted helplessly for more than a year, her company being the first of the human race to go through the long Antarctic night. Though equipped meagrely and at small cost, the *Belgica* was charged to the highest degree with scientific enthusiasm, and accumulated an almost incredible mass of scientific material and data. Amundsen learned eagerly what his scientific friends could teach him, and from his earlier experience he knew that fresh meat was necessary in order to escape scurvy, but he said that he could not convince his superior officers of this until after the terrible disease had got a firm hold on the ship's company. Then when the command devolved temporarily on the first mate, he insisted on the use of the seal and penguin meat he had stored up months before, and this had the happiest result.

On his return in 1899, Amundsen obtained his master's certificate and, equipped with the experience of ice-navigation, scientific observing, and polar hygiene, he prepared for an independent venture, resolving to be the first to traverse the North-West Passage and to study the locality of the north magnetic pole. He made the acquaintance of Nansen, who approved the scheme and gave him introductions. An attempt to get instruction in magnetic work at Kew met with a rebuff, but Dr. Georg von Neumayer welcomed the young Norwegian at the Deutsche Seewarte and secured for him further instruction at Potsdam. After mastering the technique of magnetic observations, Amundsen bought an old fishing smack 72 feet long, 11 feet wide, and 50 tons burden. He named her the *Gjoa*, fitted her with an auxiliary motor engine, then a novelty for a sea-going ship, and spent the summer of 1902 in oceanographical work off the Norwegian coast. He made the usual efforts to collect funds for his expedition from scientific societies, government grants, and private individuals, but when he had gathered a small band of kindred spirits and loaded his stores, there were still unsatisfied creditors who threatened to seize the ship. Amundsen resolved to elude these by a midnight start, and got away unobserved one day in June 1903. He crossed to Greenland and made his way in the track of Franklin. For two years he remained on the shore of Boothia Felix close to the magnetic pole, and secured a fine series of automatic magnetic records and a great collection of Eskimo handicraft from a tribe of 200 nomads who camped near him and knew nothing of white men except their grandfathers' stories of Franklin's time.

When free to move in August 1905, the *Gjoa* felt her way through the shallows of Simpson Strait, and after three weeks of acute nervous tension Amundsen's anxiety was changed to triumph by meeting an American whaler which had come through Bering Strait. The *Gjoa* had to spend another winter in the ice before she gained the Pacific, and, characteristically, Amundsen presented the little ship to the City of San Francisco as an historical memento, and she was placed on permanent exhibition in the Golden Gate Park. The expedition had been a splendid success, a worthy end to four hundred years of foiled endeavour.

Two strenuous years of lecturing in all the countries of Europe and in America brought Amundsen money enough to pay the debts of the *Gjoa* expedition. The next prize of exploration for which he lusted was the attainment of the north pole, and to secure this he resolved to emulate Nansen's drift in the *Fram*. He laid his plans, the Norwegian government gave him the famous old ship, and geographers of all nations smiled on the enterprise, preparations for which were nearing completion when in the autumn of 1909 the news of Peary's success demagnetised the north pole of its stimulus to future exploration. Amundsen was grievously afflicted, but a new objective soon captured his heart. When Shackleton, fresh from his great Antarctic journey, lectured in Oslo later in the same year, Amundsen was a rapt listener. Lady Shackleton says that when her husband in a climax of eloquence quoted a verse of Robert Service about the call of the wild, a mystic light shone in Amundsen's eyes as if he had seen a vision, and she believes that at that moment he took his decision, but he kept it to himself.

In June 1910 the *Fram* was equipped and ready; her company, like all the world outside, thought she had started for Bering Strait and the Arctic Sea; but Amundsen sailed with the sealed orders of his great ambition locked in his heart. At Madeira for the first time he declared his intentions; his comrades gloried in the idea of a race with Scott to the south pole; the outside world was struck with amazement. Amundsen left a cable to be sent to Scott, who was already in New Zealand, but his mind was uneasy at the thought of the criticism his action would call forth. If both expeditions had been planned only for the advancement of science, there would have been no rivalry but only effective co-operation, and in fact the meteorological observations made by the Norwegians and discussed by Mohn proved of value in supplementing those of Scott's parties. Amundsen's was confessedly a push to get first to the pole, and if he was given the desire of his heart, who can say whether leanness did not also enter into his soul? His expedition was a model of foresight, equipment, and efficiency; it went like clockwork, everything happened as planned, and on Dec. 14, 1911, Amundsen and his four comrades were the first men to reach the south pole. The return journey was as smooth and successful as that outward.

The achievement marked the zenith of a great man's power; it was the finest polar journey in history. There followed the usual circle of lectures, feasts, and honours, but Amundsen had grown morbidly sensitive and searched every proffered tribute for a hidden slight. He felt bound to carry out his original project of drifting over the north polar area though the prospect seems to have lost its charm. Still, he proceeded with the equipment of an expedition on the *Fram*, which included an aeroplane, when the War broke out and he felt that he could not go.

By speculation in shipping Amundsen amassed a small fortune in the earlier years of the War, though a less mercenary man never lived. He put all his money, as he put all his strength, into the furtherance of his schemes of exploration. Now he proceeded at his own expense to build a polar ship, the *Maud*, and to bring together a new staff for investigating the Arctic Sea. In 1918 he was ready, and was informed that at his request a safe conduct from German submarines might be given, but his horror at German naval methods had led him a year before to return his German decorations to the Kaiser, and he refused to ask any favour now. The *Maud* skirted the coast of Norway and entered the Kara Sea, proceeding eastward beyond Cape Chelyuskin before being frozen in. In 1919 she was released in September and proceeded on her way; but two of her crew had left the expedition and were lost for ever in Siberia.

Another winter had to be spent icebound on the Siberian coast, and in July 1920 the *Maud* had to proceed to Nome in Alaska, having accomplished the North-East Passage for the second time in history. Here four more of the party returned home, and the *Maud* at last set out for her drift with a complement of only four men, including Amundsen. Their attempt, hopeless from the first, led to nothing but misfortune. The ship had her propeller damaged, and after a third winter frozen off the coast of Siberia, she had to return under sail to Seattle for repair in 1922.

Amundsen returned to Norway, raised more funds, and became obsessed (the word is his own) by the idea that the future of polar exploration lay in the air. Returning to America he bought a Junker aeroplane and brought it to Alaska in the *Maud*, which proceeded under Capt. Wisting due north into the polar drift, while Amundsen, his aeroplane, and pilot were taken in a coasting schooner bound for Point Barrow, hoping to fly from there to Spitsbergen. They had to land, however, at Wainwright Inlet, where Amundsen left the machine and returned overland to Nome, making a journey of 800 miles over the snow on foot at the average rate of 50 miles a day. Such were his strength and fitness at fifty, yet he had been warned by a heart specialist nine months before that he must do no more exploring and avoid strenuous exertion. In summer he returned to the shore of the Arctic Sea, only to find his aeroplane damaged beyond repair. For the next two years his life was a nightmare of efforts, first to obtain new aircraft, then to right his utterly disordered finances. Friends turned against him, and it even seemed as if his career was ending in disaster.

At its lowest the tide turned with the advent of a wealthy and adventurous young American, Mr. Lincoln Ellsworth, who placed his resources and his cheering companionship at the disposal of the prematurely ageing explorer. Together they planned a flight in two flying boats from Spitsbergen to the north pole and back. The attempt was made in the early summer of 1925, and the boats had reached 88° N. when one had to descend from engine trouble and was found to be useless for further flight. The other joined it on a narrow lead of open water which rapidly froze, and for three weeks the six men toiled to level the rough ice and make a smooth runway along which the boat, fitted with ski for the purpose, could get up speed enough to rise. By something little short of a miracle this was achieved, and when the most hopeful had begun to fear the loss of the explorers, the little flying boat with twice its proper number of passengers dropped safely on the sea at Spitsbergen.

Before this narrow escape Amundsen had decided that the proper aircraft for polar flights was a lighter-than-air dirigible. Now Mr. Ellsworth purchased from the Italians a modified dirigible which was renamed the *Norge*, and in 1926 she flew safely to Spitsbergen. Here, while waiting for propitious weather for her flight to the north pole, Amundsen had to experience something of the emotion which he had caused in Scott at the south pole, for the American, Capt. Byrd, arrived at Spitsbergen with an aeroplane on which he flew to the pole and back before the *Norge* could make a start. Amundsen lost the first place in this polar race, but very speedily the *Norge* followed, reached and hovered over the pole, and then proceeded on her way across ice-laden seas previously unseen by human eye to Alaska, where the cruise ended successfully. Col. Nobile, who had designed and built the *Norge*, sailed in her as chief pilot, but the relations of the Norwegians and Italians became so strained that there was an open rupture on their return.

Amundsen's work was done. He achieved another climax of popularity, it is true, but his nerves were worn with years of strain and hardship, and the joy of his unequalled triumphs at both ends of the earth failed to outweigh the memories of the struggles, the disappointments, and the alienation of friends. He was prematurely aged, solitary, and despondent, when in the early summer of the present year Gen. Nobile set out in the *Italia* to outdo the exploits in the *Norge*. When the great airship met with disaster, the last dramatic scene

(*Continued on page* 545.)

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Reviews.

A Pioneer of Electrical Engineering.

Reminiscences. By R. E. Crompton. Pp. xv + 238 + 8 plates. (London: Constable and Co., Ltd., 1928.) 14*s.* net.

COL. CROMPTON is one of the few men now living who have clear recollections of the 1851 Exhibition in Hyde Park. When a child of six, accompanied by his mother, he came up to the Exhibition in a special train from Thirsk to King's Cross. The train was incredibly long, every seat was occupied, and it was drawn by six engines. Naturally, he was impressed by Paxton's wonderful crystal building shining and glistening in the sun, very different in appearance from the clumsy concrete buildings of the Wembley Exhibition. He dragged his mother to the machinery hall at one end of the Palace. Neither the Koh-i-noor diamond nor any of the numerous side-shows had any attraction for him comparable with the locomotives with their brilliantly polished piston rods and brasses burnished like gold. This had doubtless the effect of giving an engineering bent to his after life.

Crompton was born at Lion Hill, near Thirsk, in 1845. His father, who had been educated at Jesus College, Cambridge, did valuable diplomatic work, sometimes travelling on secret missions disguised as an Arab. His mother was the niece of Robert Burns's "Lass of Ballochmyle." She was very musical and was a friend of Mendelssohn. Colonel Crompton was their fifth and youngest child. He seems to have been a precocious boy. He remembers how in London in 1851 the steel-wheeled and horse-drawn vehicles rumbled over the granite-block paving with a deafening noise. Owing to this noise conversation was often impossible between him and his mother in busy thoroughfares.

Amongst Crompton's early schoolfellows was Dodgson the mathematician, better known as the author of "Alice in Wonderland." At the outbreak of the Crimean War his father, who was an officer in the militia, volunteered to take his battalion to the front. He was ordered to Gibraltar so as to relieve line regiments who were going to the Crimea. He took his family with him. During his stay his wife's cousin, who was the commander of H.M.S. *Dragon*, was allowed to take young Crompton on board his ship to the Crimea. Possibly his parents thought that naval discipline would be good for him. He started as his cousin's guest, but eventually it was found necessary to enrol him as a cadet in the Royal Navy. He thus commenced his service to Queen Victoria at the age of ten. When he arrived at the Crimea he went to visit his brother, who was in the trenches before Sebastopol. He thus gained, sixty years before the War, first hand knowledge of trench warfare. The shells were called 'Whistling Dicks,' and the flare-shells for lighting the no-man's-land 'Carcasses.' During the armistice after the great assault on the Redan, he found in front of the trenches countless lead bullets which appeared at first sight to be a bluish sort of gravel. Although he was only a child of eleven, yet as he had been in the firing line, he was awarded a medal and clasp.

On his return to England Crompton finished his education at Elstree and Harrow. Afterwards, when staying with his brother at Farnham, they rode over and saw the famous Sayers-Heenan prize-fight—a most unpleasant spectacle. During his holidays at Harrow he began to construct a full-sized road engine. At this time Messrs. Cook of York, and George Salt of Saltaire, were both building road engines, and he met and discussed with them various difficulties. This led to him fitting his engine with the differential gear now practically used in all road vehicles. The motive power for the machine lathe in his small workshop was a man who drove a large flywheel by hand.

In 1863, Crompton passed second in the examination for direct commissions in the army, and the following year was gazetted an ensign in the Rifle Brigade and sailed to India. The Suez Canal being still unfinished, he went overland from Alexandria to Suez. In India he finished his road engine, which made good progress on main roads. Hearing that R. W. Thomson of Edinburgh had got excellent results by using very large and thick rubber tyres on tractor wheels, he got into communication with him and official tests were made of the Thomson engine. The results proved that mechanical haulage could advantageously be used to replace bullock haulage for Army and Post Office work. This marks an important epoch in the history of the development of automobiles. Before this, agricultural traction engines were the only ones allowed to be used in England, a man having to walk in front of them with a red flag to set the pace.

Crompton's Indian experiments were the first to show on an adequate scale what could be done with steam power on the road. The only available power at that time was steam. The internal combustion engine was not developed until about twenty years later. In 1875, Crompton returned to England and ended his personal connexion with the development of road transport in India. He found that mainly owing to the fear that the interests of horse haulage would be injuriously affected, there was little opening for an engineer for road haulage in England.

Having read of the developments of arc lighting in France by Gramme, Crompton entered into partnership with Mr. Fawkes to import electric lighting apparatus from France. Shortly afterwards he inaugurated the firm of Crompton and Company, electrical engineers, at Chelmsford. At the Paris Exhibition in 1881 they were awarded the first gold medal ever given for electric lighting plant. Early in 1882 his firm installed a complete electric lighting plant at the Mansion House. A 16-horse power Crossley gas engine in a basement room drove a dynamo by means of a belt. The lighting was a success, but one evening the belt came off the pulley and was flung alternately against the ceiling and floor of the dynamo room. People in the building were terrified by the banging noise, imagining that the Lord Mayor and his guests were being attacked by Fenians, of whose designs everyone was then talking.

The great fire which destroyed the Ring Theatre in Vienna in 1883 was indirectly the means of providing Crompton with the opportunity of experimenting on large scale electricity supply. The Emperor Francis Joseph was so impressed by the dangers of gas lighting that on the advice of the gas company he consulted Crompton. The result was a five-wire supply on the direct current system. In 1886 the Opera House was illuminated by electricity. The Crown Prince Rudolph was looked on by Crompton as one of his pupils, and it was through Crompton that he was first introduced to the Baroness Vetsera, who afterwards became his morganatic wife. The tragedy of 1889, when they were both found dead, he attributes to murder and not to suicide.

The German system of doing work on deferred payment terms with the help of their bankers, on what is known as the group bank system, prevented Crompton's from getting much continental business. In 1890, Crompton read an important paper to the Institution of Civil Engineers on the generation and distribution of electrical energy, pointing out for the first time the importance of the 'load factor' of a station. Between 1890 and 1899 he was busy on electrical work in all parts of the world.

In October 1899 the Boer War began, Crompton volunteering at the earliest possible moment. After many unpleasant experiences he organised a fleet of transport engines and waggons and did military work of great value.

In 1906, in conjunction with Le Maistre, Crompton drew up the constitution of the International Electrotechnical Commission which has done excellent work in standardising apparatus and in drawing engineers of all nationalities together in bonds of friendship. The first three presidents were Kelvin, Mascart, and Elihu Thomson, the last being the originator of the international scheme. The great success of this commission is largely due to Crompton, who was for so long its honorary secretary, and is now the honorary president.

In 1910, Crompton was elected engineer to the Road Board, on which he has done valuable work. In 1914 he offered his services to the War Office, to help in the mechanisation of the army, but his offer was rejected. In 1915, however, Mr. Churchill applied for his services. He did work of great value in connection with the design of tanks of all kinds.

Twenty-eight years ago, Crompton was enthusiastic about the many boons that would ensue to Great Britain if a cheap electrical supply became universal. England would no longer be spoilt by densely populated industrial centres, and cottages would be evenly spread over the kingdom. The factory hands, instead of having to work under shafting in factories, would be able to carry on their industrial pursuits in their own cottage homes. This has been done in Switzerland, in Sweden, and in many other places abroad. Colonel Crompton is doing his utmost at present to enable his ideas to be put into practice, and everyone will hope that he will be as successful in the future as he has been in the past.

A. RUSSELL.

The Devil-Worshippers of Kurdistan.

The Cult of the Peacock Angel: a Short Account of the Yezîdî Tribes of Kurdistan. By R. H. W. Empson. With a Commentary by Sir Richard Carnac Temple. Pp. 235 + 6 plates. (London: H. F. and G. Witherby, 1928.) 15*s*. net.

TURKISH rule over alien peoples had some defects, but it had one merit which is of supreme importance in archæological eyes. Sporadic outbursts of political fanaticism apart, it left social, religious, and linguistic independence to the different races that were subject to it. Thus it preserved a great deal of material that is valuable to the modern student.

One of the most puzzling exhibits in what may be called the Turkish museum is the group of tribes known as Yezidis in their own habitat of Kurdistan and as devil-worshippers in Europe. They are very difficult to label accurately in detail. How far do they really worship the devil ? Who is the 'peacock angel' whom they adore ? Do they belong to any of the great religions of humanity; and if so, to which ? What does the word 'Yezidi' mean ? Of what race are the tribes ? In the book under review, Mr. Empson sets out the answers which his reading and personal investigations enable him to offer to these and other questions.

In dealing with the first, he points out that a being like the devil who can do harm may be propitiated and consequently cajoled out of carrying his evil purposes into execution. Hence he considers that the Yezidis placate—with some exaggeration perhaps—rather than worship the devil. In the commentary which enriches Mr. Empson's book, Sir Richard Temple accepts this view and supports it by examples from India. Other examples exist in the Mediterranean area. Sailors, for example, placate the sea-demon of Cape Linguetta in Albania with offerings of bread. In the same spirit the ancient Greeks spoke the Black Sea fair and called it the Euxine, the Favourable, rather than the Axine which it was in reality.

As to the second question, Yezidis believe that the devil would be offended if he were named. Consequently they address their apotropaic cult of him to a proxy called Melek Taus, the 'peacock angel.' Sir Richard Temple attributes their choice of proxy to confused memories of the Mohammedan version of the temptation, in which a peacock appears as the intermediary between Eve and Satan. According to a legend related (was it collected ?) by Mr. Empson, the Yezidis themselves say that Satan snatched Christ from the Cross. Failing at first to convince the women mourning by the empty tomb that he had done so, he took a dead cock and restored it to life to prove his power. Then, informing them that he wished to be worshipped thenceforth as a peacock, he vanished. Sir Richard is certainly happier in his suggestion than the Yezidis, for they have only borrowed the story of the empty tomb from the canonical Gospels and the story of the revival of a dead cock from such Christian legends as the early tale of St. James of Compostella and its Syrian prototypes.

Question three is most interesting. To answer it Mr. Empson gives details of the religious beliefs and customs of the Yezidis. These include respect for running water and for certain trees, sun worship, regard for fire, traces of dualism, baptism, a (rather cursory) fast of forty days in spring, belief in purgatory, reverence for Christ and the symbol of the Cross, blood sacrifices, circumcision, transmigration of souls, ablutions before worship, and certain funeral rites. On the evidence, Mr. Empson will say no more than that the Yezidi religion is highly syncretic. Sir Richard Temple, noting the Mohammedan environment of the tribes, calls it an extremist form of Islam with borrowings from the different religions with which the Yezidis have been brought into contact during their wanderings.

Writing after long and intimate experience of Bulgars, Greeks, and Albanians who have deserted Christianity for Islam, I would go further. I would regard the Yezidis as having passed successively from animism to Sabæanism (less probably Christianity) and finally to an imperfect form of Shia Islam. In my opinion funeral rites are the most decisive test of a faith. Most of the Yezidi funeral practices, notably the washing of the dead, the burial of sacred earth with him, the shielding of his remains from the surrounding earth, his inquisition by angels, and the funeral feast at his tomb, are Shia practices and range the Yezidis with the Shias. Turkish massacres of Yezidis are not inconsistent with this classification, for Turks have always hated sectarians of their own faith more than members of alien faiths. The massacres of Anatolian Shias by Sultan Selim and of Bektashis by Sultan Mahmud are cases in point.

By the theory of progressive, but always partial, conversion of the Yezidis from one religion to another, such anomalies as baptism in their present practice would be explained, more easily, as survivals from their previous religion rather than as borrowings from neighbouring creeds. Such saints as Sheikh Adi would fall naturally into place as the propagandists responsible for the change of faith. Such minor difficulties as the Yezidi taboo on the name Gurgis would disappear. For Nebi Gurgis, Saint George, is a prominent Christian saint in the Mosul district near which most of the Yezidis live. As such, he would have had to be camouflaged as Khidr or disowned by the Yezidis at their adoption of Islam. In this connexion we wish that Mr. Empson had given us a list of Yezidi names.

As to the meaning of the word Yezidi, Mr. Empson seems to relate it like the Yezidis themselves to their alleged descent from the Caliph Yezid. Their racial origin he, very prudently, thinks must be left to anthropologists to solve.

Altogether the book is most interesting. Unfortunately bad planning has made it hard to read. Thus the chapter entitled "The Origin of the Yezidi Tribes" discusses the origin of three things, namely, the doctrines, race, and name of the Yezidis, but the discussion never separates one origin clearly from another; and in his next book, will Mr. Empson not name his authorities, and put subjects as well as persons and places in his index?

MARGARET HASLUCK.

An Eclectic Bibliography.

The Subject Index to Periodicals, 1926. Issued by the Library Association. Pp. ix+278. (London: Grafton and Co., 1928.) 70*s*.

THE desirability of possessing lists of references, kept as up-to-date as possible, is apparent to every investigator, whatever the field of knowledge in which his interest lies. For the individual to compile his own subject index from original sources of information, an enormous amount of time and labour is required. It is the function of published 'bibliographies' to provide him with the required material in the form of references to original papers and, in some cases, as abstracts of the articles to indicate their scope. There are two requirements which a list of references must fulfil if it is to be of real practical value: it should be as complete as possible; and it should be suitably classified by subject. No bibliography, however specialised, is complete. No bibliography can be complete. In the restricted field of science alone, the number of articles published each year is probably of the order of one million, and these are distributed through some fifteen thousand current scientific periodicals ("The World List of Scientific Periodicals," of which vol. 1 was published in 1925, and which was admitted to be incomplete, contained entries of more than 24,000 scientific periodicals in existence since 1900). Of this number of articles a comparatively low percentage is indexed in bibliographies. A great proportion is lost to those investigators to whom they would be of extreme use. It is true, of course, that the majority of articles of outstanding importance are mentioned in abstract or reference journals; but who is to determine the value of an article to an individual?

The first thing that one would welcome, therefore, in a modern subject index is a wide range of literature covered.

The second important feature is an efficient classification according to subject. In this, the majority of indexes are sadly deficient. At least one hundred and fifty systems of classification have been devised, but editors of indexing journals, in most cases, are very shy of adopting any system, however valuable it may have been shown to be in practice.

In the light of these two considerations, scope and classification, it is interesting to consider the present publication of the Library Association. The "Subject Index to Periodicals" was begun in 1915 to provide a general index to periodical literature. Volumes were issued, either as consolidated volumes or as Class Lists, covering the literature up to 1922. The work of publication became considerably in arrear, and in order to bring it up to date the volume for 1926 has now been issued. The volumes for 1923 to 1925 are in course of preparation.

The volume for 1926 contains some 21,000 entries, covering about 600 periodicals. The Class List arrangement is discontinued, the arrangement of the present edition being alphabetical by subjects, based upon the Alphabetical Subject Headings of the Library of Congress. The classification possesses the well-known disadvantages of an alphabetical system of classification, but in practice the system used here appears to be as convenient and useful as this method of classification can be.

It is in the very small range of literature covered, that the chief source of disappointment lies. The work is not confined to scientific subjects, and yet it deals with only 600 periodicals, whereas in the field of science alone there are some 15,000 current periodicals. No serious attempt seems to have been made towards a judicious selection of the type of periodicals selected for indexing, or to a discrimination between articles according to their obvious value as sources of new or sound information.

For the scientific investigator the work is of little value. It cannot hope to compete with the well-known specialist abstract journals. Moreover, it is stated in the preface that a few of the more technical periodicals, which are covered by printed abstracts, have been excluded. The method of selecting the periodicals for exclusion seems to be very arbitrary. For example, the *Philosophical Magazine* is included, while the *Proceedings of the Royal Society* is omitted. Many of the popular scientific journals are indexed, while most of the important journals containing original papers are excluded.

For public libraries the work may have its uses. But even here it would need to be used in conjunction with other bibliographies. Otherwise, a very erroneous impression of the literature of a particular subject will be obtained. If one may be excused making suggestions, the following would appear to be the system of editing which would make the work of greatest value : That in future editions the guiding principle be that of providing the ordinary non-specialist, who uses chiefly a public library, with a survey of the most important papers published on the subjects in which he is interested. That the most satisfactory way of achieving this would probably be to use the services ot a staff of specialists. Each specialist would be acquainted with the literature of his subject, and would provide a list of references to the most important articles on his subject, gleaned from as wide a range of journals as possible. In this way a bibliography would result which would be of far greater value than that compiled by indiscriminate indexing of articles, good and bad, from a limited number of periodicals, and excluding many of the most important sources of information.

It is not the intention of this note to belittle the work done by the Library Association and its large number of voluntary contributors. Their work is very praiseworthy, and is purely a labour of love. It is rather to suggest that the results of their labours would be of greater value if directed along lines somewhat different from the policy which appears to be followed at present. W. Clark.

Biology of Insects.

The Biology of Insects. By Dr. George H. Carpenter. Pp. xv + 473 + 16 plates. (London: Sidgwick and Jackson, Ltd., 1928.) 16*s*. net.

In the insects, perhaps more than in any other group of animals, the biological interest outweighs the morphological. In fact, as Dr. Carpenter says in his preface, the great wealth of facts makes a careful choice of material not only necessary but also very difficult. Any omission is sure to disturb some critic. The plan of Dr. Carpenter's book is reminiscent of that adopted in many recent German text-books. The structure, physiology, and sense-organs are described in the earlier chapters, while the later ones show what use insects make of their endowment.

This treatment leads to six (out of the total of fourteen) of the chapters being predominantly concerned with morphology. Perhaps, if the amount of morphology had been reduced, especially in those aspects which Dr. Carpenter has treated more fully in his previous books, room might have been found for certain topics that have not, or only inadequately, been treated. The question of parasitism and its relation to and development from the carnivorous habit would have provided the material for a long and interesting chapter on a subject of increasing economic importance. The last chapter, on insects in relation to mankind, is full of 'old familiar faces,' while some of the interesting modern work (*e.g.* in Australia) is unmentioned. There is little exposition of the principles governing applied entomology; no indication, for example, of the difference between attacking a pest living in its native country and one which has recently been introduced into an area where its enemies are lacking; nor are the causes of insect outbreaks discussed in any detail.

These objections are not, perhaps, altogether admissible against a book which will, in any case, contain a great deal which is new and interesting to those who are not specialists in the subject.

In certain cases recent work has made it necessary materially to modify some of Dr. Carpenter's statements. Thus, on p. 145, the generalisation that "in every case we find the form and action of an insect's ovipositor suited to the position in which eggs have to be placed" is very sweeping. In the case mentioned of Phasgonurid grasshoppers, Grasse has actually shown (*Bull. Biol. France et Belgique*, **58**, p. 454; 1924) that species with similar ovipositors often lay their eggs in very different substrata and vice versa. The statement on p. 202 that it is the brighter-coloured sex which carries the other on the nuptial flight has not been borne out by recent observations. Warren (*Ent. Record*, **32**, p. 218; 1920) points out that while the greater activity of one sex or the other in the nuptial flight is highly specific to particular genera or families, it is not generally correlated with colour. The account of the solitary bees, *Halictus*, on p. 225, is defective, for Stöckhert (*Konowia*, **2**,

p. 48 ; 1923) has recently shown that many species are truly social and have a real worker caste, offspring of the hibernated females. In the interesting summary of the activities of termites (p. 253) there is no account of Cleveland's work proving that termites are able to eat such quantities of cellulose only by the help of their symbiotic intestinal ciliates. The acceptance of Dr. Harrison's interpretation of his experiments with the gall-making sawfly, *Pontania*, is a more debatable point. The proof that the instinct to lay on a new food-plant has been impressed on the germ-plasm is by no means rigid ; it is equally possible that the experience of the larva of the special chemical properties of the new food-plant has been handed on to the adult with the larval central nervous system, which is little modified in metamorphosis. Such a method of instinct-evolution may well be very important amongst insects ; it is possible that some of the pests which have arisen in recent years through alteration in the normal food-plant (*e.g. Orchestes fagi*, p. 111) illustrate the same process.

Of the illustrations, the photographs (many of them taken by Mr. H. Britten) are excellent, both in their technique and in the story they tell. There is a useful bibliography and index, though the latter, unfortunately, does not include the names of authors mentioned in the text. No misprints have been noticed, but on p. 381 *Scæva dryadis* is a fly and not an aphis ; this mistake, however, is due to an error in the work there quoted. On p. 382 also, *Leria* (fam. Helomyzidæ) would not normally be called a midge. Dr. Carpenter's book is likely to provide many with a useful introduction to a very large subject.

Microscopic Life in Drinking Water.

The Microscopy of Drinking Water. By Prof. George Chandler Whipple. Revised by Prof. Gordon Maskew Fair and Prof. Melville Conley Whipple. Fourth edition, rewritten and enlarged. Pp. xix + 586 + 19 plates. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1927.) 35*s*. net.

THIS book deals with a subject which is of practical importance to the water engineer, and presents at the same time a biological problem of a quite fascinating kind, namely, the symbiosis, to use the word in a purely literal sense, of microscopic organisms. One can imagine with what keen interest Darwin would have reflected upon the problem, if the materials for its study had been available to him. Let it be said now that this is a well-written and well-arranged treatise, which combines an enthusiastic interest in the subject with a sound judgment upon its practical aspects. Naturally, perhaps, American experience has been drawn upon for the purpose of illustration, and yet the book would have gained in comprehensiveness if the editors had given more space to the observations of workers in other countries.

The term 'microscopic organisms' is virtually equivalent to the term 'plankton,' and relates to the organisms (except the bacteria) that are invisible to the naked eye, and inhabit streams, lakes, ditches, and other bodies of fresh water. The common organisms in drinking water include algæ, fungi, protozoa, rotifera, crustacea, bryozoa, and sponges. Taken altogether, 187 genera—108 plants and 79 animals—have been recorded, but of these only 10 genera cause serious trouble. The bacteria are not considered in this volume. They make drinking water unsafe, whereas the microscopic organisms make it unsavoury. These organisms do not thrive in grossly polluted water, and therefore they do not indicate pollution of the water by sewage.

From the point of view of the biologist the study of the microscopic organisms concerns the mutual relations, whether helpful or inimical, of their life processes, and their reactions to the physical environment and to more highly developed types of living organisms. Thus fresh-water fish feed on crustacea and insect larvæ ; the crustacea prey upon rotifera and protozoa ; the rotifera and protozoa feed on algæ and bacteria ; and the algæ absorb soluble substances and gases provided in part by the decomposition of animal and vegetable matter brought about by bacteria.

The circumstance that the microscopic organisms are more numerous in the surface layers of lakes and reservoirs than in the deeper strata is doubtless explained as an effect of light, which stimulates the metabolism of the chlorophyll-containing organisms by inducing photosynthesis, the process whereby carbohydrate food materials are built up from carbon dioxide and water. Temperature has a marked effect on the plankton, and it would have been interesting if reference had been made to the influence of this factor upon the water supplies of tropical countries. Aeration is another important factor. Chambers found that aeration tends to the formation of individual cells of algæ, and that in poorly aerated water the tendency is rather towards the production of colonies and filaments. The hydrogen-ion concentration of samples of water taken from varying sources and under varying conditions, and its relation to the plankton, is a part of the subject which until recently has been inadequately investigated owing to the lack of a sufficiently simple technique.

An interesting chapter deals with the microscopic organisms met with in water pipes and aqueducts. Here the absence of light and the growth of sponges on the walls are not favourable to the plankton. Covered conduits harbour fungi, sponges, hydrozoa, bryozoa, crustacea, insect larvæ, worms, and molluscs. 'Pipe moss' is the popular name for the branching furry growths of hydrozoa and bryozoa.

The somewhat ill-defined group of organisms which includes leptothrix and crenothrix has many times been a source of trouble in water supplies. They are filamentous forms and are surrounded by a sheath upon which ferric oxide or hydroxide may be precipitated. If present in excess they give a milky appearance to the water or a rusty-iron colour, and a musty, fishy or otherwise disagreeable odour.

Much has yet to be learned concerning the chemical nature of odoriferous substances derived from microscopic organisms. In most cases the odour is caused by compounds analogous to the essential oils, and in many genera the oil globules may be seen within the cell, especially before sporulation or encystment. The cucumber taste and odour have been a frequent cause of complaint against the Boston water supply. This was at first attributed to a sponge (*Spongilla fluviatilis*), but it is probably due to *Synura*, a free-swimming protozoon grouped in "subspherical social clusters" and commonly present in swamp waters. The aromatic odours sometimes associated with drinking water are due chiefly to the diatomaceæ. Two species of protozoon possess an aromatic odour; *Cryptomonas* smells of violets and *Mallomonas* has a similar odour, which, however, when strong, becomes fishy.

An account is given of the method devised by Moore and Kellerman (1904) of controlling algal growths in water supplies by means of copper sulphate. Mention is made of the plan of scattering the copper sulphate on the frozen surface of reservoirs, thereby ensuring a uniform distribution when the ice melts. This salt does not exterminate the algæ, and the resistant cells survive to act as a seed for a later outbreak. There is no evidence that the organisms acquire resistance to the repeated action of the copper sulphate. Chlorine is preferred by some as an algicide, and its addition in amounts greater than the minimum lethal concentration destroys the odour and taste-producing oils that are liberated from the dead plankton. The removal of the excess of chlorine is effected by means of sulphurous acid, or sodium sulphite, bisulphite, or thiosulphate.

The second part of the book is devoted to a systematic account of the classification and characteristics of the microscopic organisms which are met with in drinking waters. G. F. P.

Text-books of Physical Chemistry.

(1) *Introduction to Physical Chemistry.* By Sir James Walker. Tenth edition. Pp. xii + 446. (London: Macmillan and Co., Ltd., 1927.) 16*s*. net.

(2) *Elementary Physical Chemistry.* Adapted from "A Treatise on Physical Chemistry." By Prof. Hugh S. Taylor. Pp. ix + 531. (London: Macmillan and Co., Ltd., 1927.) 16*s*. net.

(3) *Theoretical and Experimental Physical Chemistry.* By Dr. James Codrington Crocker and Dr. Frank Matthews. Pp. viii + 581. (London: J. and A. Churchill, 1927.) 21*s*. net.

(4) *Lehrbuch der physikalischen Chemie.* Von Prof. Dr. Karl Jellinek. Fünf Bände. Zweite, vollständig umgearbeitete Auflage. Band 1: *Grundprinzipien der physikalischen Chemie, die Lehre vom Fluiden, Aggregatzustand reiner Stoffe.* Pp. liv + 966. 82 gold marks. Band 2, Lieferung 4. Pp. 272. 21 gold marks. (Stuttgart: Ferdinand Enke, 1928.)

(1) WALKER'S "Introduction to Physical Chemistry" appears to share with Roscoe and Schorlemmer's "Treatise on Chemistry" the gift of perpetual youth, if not of immortality, since it has now reached a tenth edition, and shows no signs of decay in its twenty-ninth year. There is perhaps something in common which keeps these books in steady demand over so long a period of years, and that something (it may be surmised) is a sound appreciation of values, which has led to the retention of things that matter, even if old, and to a cautious inclusion of new matter only if likely to be of permanent utility. In other words, the secret of youth seems to depend on permitting a natural process of ageing and avoiding artificial efforts to keep young.

The present period is a trying one for writers of books on physical chemistry, since it is not easy to adhere to the new doctrine of 'complete ionisation' and yet to do justice to the older doctrine of 'reversible ionisation,' which was embodied in Arrhenius' theory of 'electrolytic dissociation.' In the present edition this problem is faced quite frankly, but it is treated with such care and discretion that there is little risk that the teacher will have to recall his words, or that the student will have to unlearn what he has been taught.

The inclusion of Rast's cryoscopic method, with camphor as the solvent, and of Baker's later experiments on the effects of intensive drying, are indications that the work done in the five years which have elapsed since the appearance of the ninth edition is sufficiently represented in the tenth edition; and this impression is confirmed by the up-to-date character of the further literature which the student is advised to read. The advice to 'read Walker' can therefore still be given with confidence to those who want to lay a sure foundation of knowledge of physical chemistry.

(2) It has always been a problem to know what book to recommend to the pass student who has 'read Walker' and now wishes to study a more advanced book for an honours course. There are a few brilliant students who can read a series of books on solutions, on thermodynamics, on catalysis, on atomic structure, and on valency, and then proceed to study the general discussions of the Faraday Society; and some students of equal ability may attempt to master the 1359 pages of H. S. Taylor's "Treatise on Physical Chemistry"; but these Herculean labours cannot safely be imposed on the honours student who is not a specialist in physical chemistry, and whose chief interest may be in some other branch of chemistry.

For students such as these, the abbreviated version of 'big Taylor' now published as an "Elementary Physical Chemistry" may be commended, since it creates immediately a new atmosphere, instead of merely telling the same story with a few additional details. Thus the first chapter on "The Atomic Concept of Matter" is dominated almost at once by nuclear and extranuclear electrons and their application to chemical theory; and in the same way the second chapter makes an early start with the thermodynamical problems which form the last chapter of Walker's "Introduction." The problem of "Energy in Chemical Systems" is thus put in the forefront of the book; and this characteristic is maintained in the later chapters, where thermodynamic treatment is used freely.

An interesting contrast is seen in the two chapters on ionic equilibria. The first deals with 'weak electrolytes' in the traditional manner, whilst the second deals with 'strong electrolytes,' from the point of view of the thermodynamic activity, and the Debye-Hückel theory of conductivity. The revision of earlier methods of teaching is here complete and entirely satisfactory; but revision is still urgently needed in the treatment of catalysis, which is discussed as if hydrogen and hydroxyl ions were the only possible catalysts in aqueous solutions, and as if neutral salts could only act by stimulating a hydrogen ion to greater thermodynamic and catalytic activity. This view is a legacy from the days when the theory of electrolytic dissociation was first exploited, and the time has already come when it should be 'scrapped' along with some other too-hasty deductions and assumptions of that period, for which the present volume provides a decent interment.

(3) Drs. Crocker and Matthews claim to have had twenty years' experience in teaching physical chemistry, but in this period they appear to have produced only about seven original papers, including one on which the names of both authors appear. This is not in itself a disqualification for writing a text-book, but it deprives the book of the adventitious aid which a text-book necessarily receives when the names of the authors are widely known as writers of authority in their own field.

The scope of the book is very similar to that of the two preceding volumes, since it is intended to include in a single volume the material necessary for an honours degree. In reality the standard of difficulty is a little higher than that of Walker's "Introduction," whilst it is certainly below that set by Prof. Taylor. Bold printing, short chapters, and a liberal series of 145 well-drawn figures make the book an easy one to read, and the questions which are usually included in an honours course of physical chemistry are adequately discussed.

If, therefore, no other alternative were available, the book could be recommended as satisfying quite well the requirements of students taking such a course. On the other hand, in the opinion of the reviewer, it does not give promise of displacing either of the two preceding volumes, since Walker's didactic skill is still without a rival in this field, and Taylor's wider experience enables him to write with greater authority when dealing with controversial questions or with unsolved problems. The student would therefore lose rather than gain as a result of paying five shillings more for the larger volume.

(4) Prof. Jellinek's "Lehrbuch der physikalischen Chemie" consists of five volumes, which it is proposed to issue yearly in three parts, at a price which will be increased by 10 to 15 per cent above the present subscription rate when the whole volume is complete. The present instalment includes the first volume of about 1000 pages at

82 marks, and one-third of the second volume, ending abruptly in the middle of a sentence on p. 272, at a cost of 21 marks. The complete work may therefore cover more than 4000 pages and cost perhaps £20. A work of this size is too big to be used as a text-book, especially when the student has to read it in a foreign language; but it is the type of book which German authors have a special skill in producing and English readers are sometimes glad to consult. The appearance of a second edition may be taken as evidence that there is a market for such a book, either in its country of origin or abroad. T. M. Lowry.

Nitrogen and Phosphorus.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By Dr. J. W. Mellor. Vol. 8: *N. P.* Pp. x + 1110. (London: Longmans, Green and Co., Ltd., 1928.) 63*s*. net.

The eighth volume of Mellor's "Comprehensive Treatise" carries the simple sub-title N.P., recalling the equally simple sub-title of the first volume, H.O. It is in many respects a critical volume, since the chemistry of nitrogen (and in a lesser degree the same statement may be made of phosphorus) has undergone an extensive transformation in many of its aspects since the first volume of the treatise was issued in 1922, and it might very well have happened that the treatise would have lagged behind, and shown signs of being a little out-of-date at this stage. A study of the new volume immediately dispels this fear, since the author has had an almost uncanny success in searching out even the least pretentious of post-War publications and setting them in place in his narrative.

This feature of the new volume is well illustrated by the sections on "The valency of nitrogen" and on "The constitution of the ammonium compounds and the ammines," where the old historic formulæ are retained in their proper setting, but are supplemented on one hand by Werner's formulæ and on the other hand by formulæ based upon the electronic theory of valency. The author's treatment of co-ordination compounds is indeed exceptionally able and authoritative, although he has not had the opportunity of acquiring this authority by original work on the subject.

The section on "Allotropic forms of nitrogen" bears the same testimony to the author's skill and perseverance in keeping his narrative up-to-date, since physical and chemical observations are cited right up to 1927, including the contents of a number of letters to Nature, which are quoted along with the more substantial contributions to scientific literature.

The sections which deal with the fixation of nitrogen have the same general character as the rest of the volume, since the author gives a very large range of references to original literature, without attempting to supply full details of technical processes, although several of the principal types of electric furnace are illustrated by simple diagrams. The sections on various nitrogen compounds contain some unfamiliar information, as, for example, that a freezing-point diagram can be drawn to demonstrate the crystallisation of solid N_2O_3 from a mixture of NO and N_2O_4, and that nitric oxide forms a transient compound with chlorine of the composition $NOCl_2$. The existence of NOBr, $NOBr_2$, and $NOBr_3$ is also indicated by the same methods.

Phosphorus provides less scope than nitrogen for interesting paragraphs, but is discussed with equal efficiency. The polar formula for phosphorus pentachloride should, however, have been attributed to Langmuir, and Sugden's evidence for the existence of a semi-polar bond in phosphorus oxychloride might have been cited. The formulæ assigned to the polyphosphoric acids are of an old-fashioned type, in which the phosphorus is generally quinquecovalent, but they are scarcely open to criticism in a treatise which has a definite historical character since the formulæ are generally those of the author whose work is being described.

Dr. Mellor is obviously not flagging in the Herculean task that he has undertaken, but on the contrary proceeds "from strength to strength," and can certainly be congratulated on the vigour and efficiency of the latest section of his work.

Marriage and Maternity.

Hymen: or The Future of Marriage. By Norman Haire. (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1927.) 2*s*. 6*d*. net.

Motherhood and its Enemies. By Charlotte Haldane. Pp. vi + 256. (London: Chatto and Windus, 1927.) 6*s*. net.

(1) Mankind being what it is, marriage must be unsuccessful in the great majority of cases. It is so because of the general ignorance of matters relating to sex, the result of a faulty sex-education, and because of prejudices, the fruits of faulty standards of sex-conduct based on the

religious and social prohibitions which doubtless once served their purposes but are now most certainly anachronous. The standards of to-day are those of the ancient Israelites as modified by the Christian Churches, and more often than not have no relation to biological fact or to modern social needs.

Mr. Norman Haire makes two assumptions. Normal sexual activity should be made possible when once puberty has been attained. Sexual congress is the primary object of marriage. He argues that there must be either early marriage with controlled fertility and easy divorce, or else premarital experience with controlled fertility, safeguards against venereal diseases, and the removal of the stigma of illegitimacy. Though he is of the opinion that the lifelong monogamous marriage is the ideal, he does not give his reasons for this opinion, and suggests that legalised polygamy will be required for the majority. He foresees the development of male prostitution, and of the eugenic conscience. One can read the book in half an hour, but to destroy or to banish its arguments will require much longer.

(2) An attitude that is commonly regarded as typically masculine is expressed in this book by one who certainly is characteristically feminine. The author, in seeking an explanation of certain aspects of sex relationships, has, with an energy that is remarkable, traced the historical development of woman in her relation to man and to the community from the earliest times, extracting from her records recipes for the cure of modern ills. She depicts the relative licentiousness of the women of the pastoral Jews, the harem-like existence lightened by the institution of slavery reaching its zenith in ancient Greece, the institution of the class of exalted prostitutes, the period of the deterioration of the respectable woman and the abasement of the prostitute class in Rome, the inception of Mary-worship and the development of celibate female orders, the middle-class revolution with its development of a social and economic ambition on the part of woman, the lessening of the incentive to maternity and the coincident increase in the demands for personal freedom resulting in the spread of feminine celibacy, and finally the effects of the War upon the position and the attitudes of women.

The author concludes that the position and the attitudes of woman to-day are the results of the introduction of Christianity with its praise of the celibate, the abolition of slavery, and of the competition of home and industry. There exists a widespread and exaggerated sentimental adulation of motherhood associated with an increasing unwillingness on the part of women to undertake its duties. She holds that the sexually normal woman is one whose career leads or should lead to mating and motherhood, and that the real enemy of motherhood is the non-reproducing female intersex who deviates more or less markedly towards the male type. In the past it has been the least womanly who have fought the battle of their sex's emancipation: it is the elderly virgin that has nurtured sex-antagonism, competing with the male economically and refusing to conform to his ideals of sex relationship. The present conflict of the sexes is due to the anti-biological influence of the Christian religion in the past and to the recent activities of the non-reproducing women, who, whilst being biologically superfluous, are socially and politically influential.

Mrs. Haldane deals with her opponents not gently; she uses the bludgeon somewhat too readily, but certainly she scores her points.

F. A. E. Crew.

Systems of Forestry.

Silvicultural Systems. By Prof. R. S. Troup. (Oxford Manuals on Forestry.) Pp. xii + 200 + 43 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1928.) 21*s*. net.

THE destruction of natural forests still continues throughout the world. In Russia, Canada, and the United States, where the great bulk of softwood (*i.e.* coniferous timber) is produced, the lumbering operations of private owners as a rule are purely destructive, since no efforts are made to secure the growth of a second crop of timber trees on the felled area. As a consequence, a famine in the world's supply of timber is predicted to come in thirty or fifty years' time. Is there no remedy? Can the problem of the world's future timber resources be solved? The answer is that in France and Germany scientific methods have been gradually evolved, by means of which the original forest areas are not only conserved but also rendered more productive. In the so-called 'managed forests' of these countries, new crops of trees come in succession on the ground, and the highest possible yield of timber is extracted year after year. This regular 'sustained yield' is much more economical than intermittent or spasmodic yields.

The different modes of scientific treatment of the forest, current on the continent, are technically called 'silvicultural systems,' and can be grouped into about a dozen forms. Transferred from Europe, these systems have been successfully applied in the government forests of India and the United States, and with suitable modifications could be practised in Great Britain.

The various systems are carefully explained by Prof. Troup in this excellent text-book, which is aptly illustrated by full-page reproductions of photographs of actual forests. Owners of large woodlands. and working foresters will find the subject presented in an interesting manner. Local examples are cited, so that the book will serve as a guide to students in quest of practical knowledge of the various systems. Botanists will be interested in the varied and often peculiar cases of natural regeneration in wild and cultivated species, as teak in Burma, white mulberry in India, lodge-pole pine and Douglas fir in North America. The seedlings of the last species often arise in areas devastated by fire, from seed stored in the ground.

The oldest system known is that of coppice, which was systematically practised by the Romans for the production of firewood, vine-stakes, and other small material; and short rotations were adopted, eight years for chestnut and eleven years for oak. The coppice system is still used in England to grow oak, ash, chestnut, and hazel. Coppice with standards is another useful system on private estates, where it is utilised partly for game preserves and partly for fencing material. This system has been employed since the twelfth century at Melton Constable in Norfolk. Plantations of exotic species, as larch, spruce, silver fir, and Corsican pine, are usually worked on the clear-cutting system in England. This practice is now imitated in South Africa, Australia, and New Zealand, where certain North American species are more profitable to grow than the native trees.

Quantum Mechanics.

The New Quantum Mechanics. By George Birtwistle. Pp. xiii + 290. (Cambridge: At the University Press, 1928.) 16*s*. net.

WHEN the history of the progress of atomic physics during the twentieth century comes to be written, three dates will certainly occupy prominent places; 1900, when Planck published his researches on the discontinuous emission and absorption of energy; 1913, when Bohr derived the Balmer series and Rydberg's constant in terms of known physical quantities from a consideration of Rutherford's model of the atom; and 1925, when the new theories of quantum mechanics were originated.

Mr. Birtwistle has already dealt with the state of the quantum theory immediately prior to the new work in "The Quantum Theory of the Atom." The present book resumes the story from 1925. In this crucial year, Heisenberg enunciated his new scheme of quantum kinematics in which the dynamical equations retain their classical form but in which the commutative law of multiplication does not hold. This is effected by replacing the classical representation of a variable in Fourier series by a matrix or table of terms built up from those magnitudes which are experimentally observable. Concurrently with this, Dirac, working on independent lines, found that the quantum conditions could be expressed by the Poisson bracket of classical mechanics. He further showed that difficulties of devising a suitable scheme of matrix differentiation could be avoided by his method, the matrix representation being only necessary to interpret the functions of the dynamical variables used in terms of the ordinary numbers in which the results of experiment must necessarily be obtained. In the same year the theory of the spinning electron was given by Uhlenbeck and Goudsmit. This theory enabled Heisenberg and Jordan to prove the g-formula, previously obtained empirically by Landé, and also to justify Sommerfeld's formula for the Paschen-Back effect.

While these theories were being explored, Schrödinger seized on the new ideas of de Broglie as to the waves associated with matter and attacked the atomic problem from an entirely different aspect, by assuming that in the case of mechanical systems of the atomic scale of smallness the phenomena should be represented by a wave motion rather than by the motion of a mass-point. He derived a differential equation for the wave function, and by means of the *eigen* functions obtained from this equation he was able to throw a fresh light on atomic phenomena. Moreover, Dirac was able to derive the Heisenberg matrices from the *eigen* functions.

Schrödinger's work was from the mathematical point of view a great advance, since the theory of differential equations on which it is based is not only more familiar but is also a more developed branch of analysis, and lends itself readily to arithmetical computation.

In the present book the author presents a complete, reasoned, and eminently readable account of all these theories. Those who have read the original memoirs as they have appeared will welcome this able summary of their important features, while others about to enter this new field will be glad to have available an account of the theories up to a definite date which will give them an opportunity of contending with the new work which is continually appearing. The subject of the last chapter, "The essential indefiniteness of quantum mechanics," has also been dealt with by Bohr in a recent Supplement to NATURE (N. Bohr, NATURE, April 14, 1928), but this need not be regarded as a pessimistic augury for the future of a field of inquiry which has all the vigour of its youth.

L. M. MILNE-THOMSON.

Brains of Apes and Men.

The Brain from Ape to Man: a Contribution to the Study of the Evolution and Development of the Human Brain. By Prof. Frederick Tilney. With Chapters on the Reconstruction of the Gray Matter in the Primate Brain Stem, by Prof. Henry Alsop Riley. In 2 volumes. Vol. 1. Pp. xxvii + 473. Vol. 2. Pp. xv + 475-1120. (London: H. K. Lewis and Co., Ltd., 1928.) 105*s*. net.

THIS massive and expensive treatise—it weighs 11 pounds 9 ounces and its price is 5 guineas —consists mainly of descriptions of the (macroscopic) form and proportions of the grey matter in the brain stems of a series of Primates. The purpose of this immense labour is not altogether apparent: for the descriptions are vague and often meaningless. The photographs that are reproduced as half-tones are for the most part blurred and indistinct; and the line drawings that are intended to interpret these indistinct photographs exaggerate their defects and in some cases introduce errors not in the photographs.

It is, however, not merely the records of his own observations and the figures that display inaccuracies. Prof. Tilney's references to other writings are untrustworthy, and in some cases the misrepresentation of the views of other anatomists is so gross as completely to invert their real opinions.

The investigations of the last thirty years have emphasised the fact that the progressive modification of the visual centres is the cardinal factor for the correct interpretation of the distinctive features of the Primate brain and the explanation of its evolution. Yet in this massive treatise on the Primate brain not only is there no reference to this matter, but also, what is even more astounding, in the closely printed 28 pages of bibliography there is no mention of (nor in the text any suggestion of acquaintance with) the work of such authorities as Monakow, Ariëns Kappers, Brodmann, Minkowski, Brouwer, and in fact most of those who have created our modern knowledge of the Primate brain!

In his foreword Prof. Henry Fairfield Osborn informs the reader that this treatise "contains the basis of what to our knowledge is the first profound study of the genesis of the intimate and internal structure of the human brain in comparison with the brains of animals more or less nearly related to man"! This daring claim could be made with any semblance of justification only by a writer who assumes that his readers are unacquainted with the works of the great neurologists of the nineteenth century and the modern treatises written by Monakow, Edinger, Ariëns Kappers, Brodmann, Oskar Vogt, Rademaker, Anthony, Brouwer, and scores of others whose work has been ignored by Prof. Tilney.

G. ELLIOT SMITH.

Scientific Backgrounds.

(1) *Religion and Science: considered in their Historical Relations.* By Charles Singer. (Benn's Sixpenny Library, No. 144.) Pp. 79. (London: Ernest Benn, Ltd., 1928.) 6*d*.

(2) *Kant's Critique of Teleological Judgement: Translated, with an Introduction, Notes and Analytical Index.* By Dr. James Creed Meredith. Pp. xcvii + 208. (Oxford: Clarendon Press; London: Oxford University Press, 1928.) 12*s*. 6*d*. net.

(3) *The Unique Status of Man.* By Dr. Herbert Wildon Carr. Pp. 216. (London: Macmillan and Co., Ltd., 1928.) 7*s*. 6*d*. net.

(4) *Nature and God: an introduction to Theistic Studies, with special reference to the Relations of Science and Religion.* By Prof. William Fulton. Pp. xvi + 294. (Edinburgh: T. and T. Clark, 1927.) 9*s*.

(5) *Naturalism and Religion.* By Prof. Dr. Rudolf Otto. Translated by Prof. J. Arthur Thomson and Margaret R. Thomson. Edited with an Introduction by the Rev. W. D. Morrison. Reissue. Pp. xi + 374. (London: Williams and Norgate, Ltd., 1928.) 6*s*. net.

WITH the increasing specialisation of scientific study, men of science are feeling the need of providing their own particular field with some more general background. Hence an increasing interest in the history and philosophy of science. Dr. Singer's small yet admirable book in Messrs. Benn's series (1) is not a history of the development of science, but a sketch of the relations in the past between the scientific and the religious interests. The author does not confine himself to modern developments, but goes back to the Ionian Greeks of the sixth century B.C., and carries us through the ancient and medieval periods to the modern. One notes with interest that he does not attribute the decline of the science of antiquity to the rise of Christianity.

"Despite the spread of philosophy based on science, the observational activity of antiquity was slowly dying in the pagan world from about 100 B.C. About A.D. 200 it expired with Ptolemy and Galen. The decay of observation, as we have seen, was the result of internally acting causes. In origin it had nothing to do with Christianity, which was not yet in a position to have its full effects on pagan thought."

Apparently, an important difference between our present attitude and that of the ancients was that whereas modern science has led to an attitude of optimism by giving us control over Nature, the science of antiquity offered no such control and led to an attitude of pessimism, since Nature seemed indifferent or hostile to man. This pessimistic attitude is displayed in Lucretius as well as in Marcus Aurelius. It is interesting to speculate whether science would lose any of its popular prestige to-day if it seemed to warrant an attitude of cosmic pessimism. Perhaps not unless its practical results were felt to be inimical to life, as the people in "Erewhon" felt to be the case with mechanical science.

Men of science in general are unwilling to suppose that either metaphysical or practical considerations can affect the future of science. Nevertheless, it is probable that more students of science are interesting themselves in philosophical problems than ever before, perhaps because science itself is becoming metaphysical. If this is so, it is not only philosophers who will be grateful to Dr. J. C. Meredith for his edition (2) of "Kant's Critique of Teleological Judgement" with the excellent introductory essays and very useful analytical index. Biologists especially will be interested in a work which discusses so acutely the relationship and meaning of mechanism and teleology. The 'critical philosophy' of Kant seems especially useful and even congenial to students of science, since, as Dr. Meredith says, it "just marks out bounds, and leaves it to Science, Art, and Ethics each to build what it is able on its own ground."

With regard to the metaphysical tendencies of science to which we have referred, physics has certainly become involved in them; and it is difficult, if not impossible, for biologists and psychologists to avoid contact with problems of a definitely philosophical nature. Dr. Wildon Carr's admirable sketch of present tendencies of thought (3) makes this clear. He indicates with great clearness the change of outlook which has taken place, by means of a contrast between the two opposing views.

"The philosophical world to-day," he writes, "is divided into two hostile camps. The ideal of the one is to be able to reduce all the phenomena of life and consciousness to the law of reciprocity, the law of the equivalence of action and reaction. The real universe is conceived as an interlocking mechanism, in which change, novelty, creation have no place. In philosophy they are materialists or natural realists. In science they are absolutists. In psychology they are behaviourists. In ethics they are deterministic and naturalistic. . . .

"The ideal of the other is to interpret all the phenomena of nature in accordance with the law of freedom, as it is experienced in the spontaneity and self-determining character of the activity of the individual. The real world is the living world. Inertia, materiality, necessity, are derivative aspects of the world, relative to the mode of living activity and its determination in actions. Those who fight under this banner are idealists in philosophy, relativists in science, voluntarists in ethics."

Altogether, this is a most interesting book, written in an easy and popular style. Not less interesting, but perhaps rather more academic in *format* and style is Prof. Fulton's work (4). He is concerned chiefly with what is, of course, the central problem, that of purpose, for theism in any form must stand or fall with this. What will interest the scientific reader most, perhaps, are two points. In the first place Prof. Fulton rejects the idea of unconscious purpose, which indeed does appear to be a contradiction in terms. In the second place, he rejects external or 'deistic' views of the divine nature and mode of action. If this is characteristic of modern tendencies in theology, certain reformulations of doctrine would appear to be due, since deistic notions are quite prevalent in orthodox circles, though not invarably recognised as such by those who hold them. The book is ably and closely argued, contains very numerous references to current literature both scientific and philosophic, and, in short, is an admirable work to place in the hands of anyone who wants guidance through the intricacies of modern speculation.

The public will be very grateful to the publishers for arranging a reissue (5) of Dr. Rudolf Otto's "Naturalism and Religion," published originally in 1907. Though now no longer new, the book is still of exceptional value. Along with the late Prof. James Ward's "Naturalism and Agnosticism," it played no small part in bringing about a change of view which (as we have seen above) has recently been reinforced from the side of scientific research itself. The numerous readers of Dr. Otto's notable work, "The Idea of the Holy," will turn to this earlier book with much interest. J. C. H.

Hæmoglobin.

The Respiratory Function of the Blood. By Joseph Barcroft. Part 2: *Hæmoglobin.* Pp. ix + 200. (Cambridge: At the University Press, 1928.) 12*s.* 6*d.* net.

THIS second part of "The Respiratory Function of the Blood" sustains the description given to the first edition of the book by its author, as the story or log of his physiological explorations, sometimes alone, sometimes with a crew, and occasionally with a pilot aboard. It deals exclusively with those aspects of the work which the author has actually touched himself or which he has delegated to some responsible member of his crew. Much of the work on hæmoglobin which has been done at Cambridge has been carried out under the auspices of the Hæmoglobin Committee of the Medical Research Council. To them and to his various pupils and collaborators the author expresses an indebtedness which must surely be fully reciprocated.

Hæmoglobin, as Prof. Barcroft says and demonstrates, is one of the most remarkable, if not the most remarkable, of substances in Nature, and it is little matter for surprise, on comparing the present volume with the previous edition of 1913, to note how greatly our knowledge of this singular compound has been augmented through the activities of the Cambridge laboratories.

We should note perhaps first the investigations by Anson and Mirsky, Robin Hill, Keilin, and others, on the chemical nature and relations of the various porphyrin derivatives. It would take us beyond the scope of a review to enter into these in any detail at all, but one of the most revolutionary points is that hæmochromogen cannot as formerly be regarded as reduced alkaline hæmatin, but must be considered as representative of a large group of loose compounds produced when hæmatin is reduced in the presence of one of a very varied group of nitrogenous substances, mostly bases. Globin, when denatured, can be one of these, but so also may nicotine, pyridine, hyrazine, or ammonia. The resulting hæmochromogens resemble one another very closely, and the one usually prepared from whole blood or hæmoglobin differs from hæmoglobin itself chiefly by containing denatured globin.

Next, the investigation on cytochrome by Keilin, and the probability that cytochrome is a mixture of hæmochromogens which is found very widely if not universally distributed throughout the animal and vegetable kingdom, is fundamental. These researches not merely extend, but also vindicate most thoroughly the investigations of MacMunn on the histohæmatins in 1886, and show that Hoppe-Seyler's criticism of these was mainly unjustified. In fifteen years the opinion with regard to the specificity of hæmoglobins has taken quite definite form. This specificity is probably due for the most part to differences in the protein part of the molecule, though minor and relatively insignificant differences due to differences in the hæmatins cannot be finally excluded.

With regard to the nature of solutions of hæmoglobin and the method of preparing these in a state of reasonable purity, great advances have also been made. The researches of Adair, for example, indicate that the molecular weight of hæmoglobin in solution as determined by its osmotic pressure is of the order of 68,000, which corresponds to four times that expected from the empirical formula, or a value of 4 for n in Hill's equation. The dissociation curve of hæmoglobin and the chemical dynamics of the union of oxygen with hæmoglobin are discussed with great clearness and in considerable detail, and in the course of this we approach a subject which has shown the most remarkable development, namely, a study of the kinetics of the oxygenation and reduction of hæmoglobin and of the formation and dissociation of carboxy-hæmoglobin in the remarkable researches by Hartridge and Roughton. These investigators, by the use of most ingenious methods, have been able to determine the length of time taken for combination between oxygen and hæmoglobin under various conditions. It is interesting to note in passing that the velocity constant for oxygenation of hæmoglobin is about 7·5 times as great as that for the reduction of oxy-hæmoglobin. The high affinity of hæmoglobin for carbon monoxide as compared with oxygen is not due to a high velocity constant for a union between the two, but to the extreme slowness with which the dissociation takes place again, so that where oxy-hæmoglobin would dissociate in a fraction of a second, carboxy-hæmoglobin would require several minutes.

There are many other interesting comparisons between carboxy-hæmoglobin and oxy-hæmoglobin which are discussed. Hæmoglobin, though apparently a very complicated and unstable substance, can be produced artificially from the proximate constituents, hæmatin and globin. Indeed, many compounds of hæmatin and other metallo-porphyrins with various proteins have been produced by R. Hill. Two interesting substances which are discussed in some detail are chlorocruorin, in which the porphyrin group is different, and hæmocyanin, which is a copper-porphyrin compound.

The various hæmoglobins and other porphyrin derivatives which are scattered so widely throughout the animal kingdom possess those properties best suited to the particular biological conditions under which each of them functions.

The book is of great interest, not merely for the large amount of information contained in it, which would not easily be available from any other source, but also by reason of the interesting method by which the author presents the subject and by the incidental anecdotes freely scattered through its pages. These give that personal touch which is so characteristic and attractive a feature of Prof. Barcroft's writings. It is a book which will be read and re-read. C. L. E.

Toxic Gases and Vapours.

Noxious Gases and the Principles of Respiration influencing their Action. By Yandell Henderson and Howard W. Haggard. (American Chemical Society Monograph Series.) Pp. 220. (New York: The Chemical Catalog Co. Inc., 1927.) 4.50 dollars.

THE authors state that the control of manufacture, handling and sale of substances which are poisonous, other than food and drugs, is inadequately dealt with by the existing Federal and State laws of the United States of America. They have therefore set out in a monograph, which is primarily intended for chemists and engineers, a classification of the noxious gases and volatile substances most frequently met with in industry, with a description of the physiological action of each, so far as it is known, and of the treatment appropriate to counteract its harmful effects on the body.

The first part of the book is devoted to a description of the physiological processes concerned in respiration, to the application of the laws of gases and vapours, and to the principles determining absorption, distribution, and elimination of volatile substances in the human body.

The control of respiration and the respiratory functions of the blood are explained at considerable length, and a reader of this volume will gain a fairly comprehensive view of modern conceptions on these matters.

Toxic gases and vapours are viewed as problems of respiration, and are therefore classified rather from the point of view of their physiological effects than of their chemical relationship. The authors divide them into four groups, namely: (1) Asphyxiants, (2) irritants, (3) volatile drugs and drug-like substances, (4) inorganic and organo-metallic substances. The asphyxiants are subdivided into: (*a*) simple asphyxiants which are physiologically inert and act by excluding oxygen from the lungs; and (*b*) chemical asphyxiants which act either by preventing the blood transporting oxygen or by preventing the tissues from using it.

The irritants are for the most part corrosive agents which injure the tissues of the respiratory tract and thus induce inflammation with a consequent impairment of gaseous exchange in the lungs. Most of the warfare gases fall into this category, but the authors are not concerned with them as such, and they are merely mentioned in their relation to industries.

The volatile drugs and drug-like substances are those which exert some action after absorption through the lungs. They consist of hydrocarbons, many of them anæsthetics, but including also the organic nitro compounds which act upon the blood and circulation, bringing about severe anæmia, and in some cases degeneration of organs such as the liver.

The inorganic and organo-metallic group includes such true poisons as phosphorus, mercury, and lead.

The chief uses in industry and the mode of action on the body and treatment, so far as they are known, are detailed under each group. Reference is also made to recent observations on the relationship between physiological action and chemical constitution, with the deductions which have been drawn therefrom.

The book is written in a very readable style and forms a valuable addition to the literature on the medical aspects of industrial hazards.

As it is intended primarily for engineers and chemists, it perhaps goes into greater detail than is necessary on the mode of action of some of the substances dealt with, for example, in the case of the volatile drugs and drug-like substances.

The authors very rightly emphasise, however, that in accidents from toxic gases in industrial plants, the saving of life is in the hands of the workers present, since in most cases medical aid must inevitably arrive too late.

Our Bookshelf.

Archæology and Ethnography.

The Nile and Egyptian Civilization. By Prof. Alexandre Moret. Translated by M. R. Dobie. (The History of Civilization Series.) Pp. xxix + 497 + 24 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopp, 1927.) 25*s.* net.

In "From Tribe to Empire," Profs. Moret and M. G. Davy drew a picture of the growth of civilisation in the favoured area of the Mediterranean and Near East, taking this to include Mesopotamia. The former now turns to a more intensive study of one of the three great cultures included in the area, namely, that of Egypt. As might be expected from Prof. Moret, the religious aspect is his special preoccupation; but in Egypt that is almost inevitable. For, as he points out, the character of the records from which our knowledge of Egyptian history is drawn, which are almost exclusively of a funerary or dedicatory nature, gives them the peculiarity of recording gratitude either towards god or the king.

Prof. Moret visualises Egyptian history, therefore, very largely in terms of the successive dominant religions. The worship of Ra represents the absolute domination of the king, the worship of Osiris the democratisation of the Empire, after an intermediate oligarchical stage, when the ascendency of the clergy of Heliopolis led to the extension of privilege to the priestly class. In the light of these views, Prof. Moret is able to provide an interpretation of the obscure relations of Hatshpsut and Thothmes II. and Thothmes III., which is at least intelligible and, be it said, more reasonable than any hitherto put forward in view of the character of the latter monarch.

Racial Synthesis in Hindu Culture. By S. V. Viswanatha. (Truber's Oriental Series.) Pp. vii + 234. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1928.) 10*s.* 6*d.* net.

This book is interesting as symptomatic of the trend of opinion among certain sections of educated India. Its aim is to smooth away distinctions and to emphasise similarities and assimilations in the numerous elements of which the Indian peoples and Indian cultures are composed. Thus, while one school of students turns from the Indo-Aryan aspect of Indian civilisation to seek for the contribution of non-Aryan peoples, the author of this volume is concerned to show, without disregarding the non-Aryan element, that there has been a fusion which has evolved a type of civilisation common to the whole country sufficient to justify its treatment as a unit in the history of the social and intellectual development of mankind. This involves the assumption of a spirit of conciliation and compromise pervading relations among the various peoples of India. It is scarcely necessary to point out that this view of Indian history involves considerable re-reading of the evidence and a revision of accepted theory which are not likely to prove wholly convincing.

Astronomy.

The Constellations and their History. By the Rev. Charles Whyte. Pp. xii + 284 + 4 plates. (London: Charles Griffin and Co., Ltd., 1928.) 10*s.* 6*d.* net.

The purpose of this book is to give an account of the constellations and stars from primitive times, which will be useful to beginners in astronomy. The first chapter contains a short account of the history of the constellation figures, and a map and description of the appearance of the heavens from the British Isles in each month of the year. This is followed by a section of about sixty pages, containing an account of the apparent motions, distances, and physical characteristics of the stars, and brief paragraphs on the nebulæ and the structure of the universe and evolution of the stars. The remainder of the book consists of descriptions of the various constellations, with historical notes and information concerning the more interesting objects to be observed in them.

The structure of the book is well conceived, and if the material had been satisfactory the book would have occupied a decidedly useful place in astronomical literature. The amateur beginner, especially, would welcome a book of this type. It must be said, however, that in spite of the author's obvious conscientious efforts to perform his task as well and as thoroughly as possible, he has not succeeded in rising to the occasion which he has undoubtedly recognised. The language, dignified rather than inspiring, is not infrequently marred by grammatical errors and looseness or obscurity of phrasing. More serious still is a misleading lack of precision which permeates the whole work and makes it impossible to regard the book as a truly scientific one. Examples might be chosen from any part; it will suffice to mention the section on magnitudes (p. 51) and to quote the following sentence from p. 66: "The whiter a star is the hotter it becomes, while the redder it is the cooler it becomes." Serious inaccuracies are much less numerous than small defects of the kind just referred to, but they can, nevertheless, scarcely be described as rare. Laplace, for example, is credited with supposing that the nebular matter out of which, according to the nebular hypothesis, the solar system developed, was originally "absolutely stationary, and consequently could not revolve on its axis." In spite of much valuable information which the book contains, we cannot recommend it to those for whom a good book of its type would be most useful.

The Fundamentals of Astronomy. By Prof. S. A. Mitchell and Dr. C. G. Abbot. Pp. xi + 307). (London: Chapman and Hall, Ltd., 1927. 15*s.* net.

This book is based on Dr. Abbot's previously published work, "The Earth and the Stars," and its scope and general character are in the main identical with those of its prototype. Large sections of the earlier work have, in fact, been reproduced, with little or no alteration, so that the new volume is effectively a revised edition of the old. The revision involves a slight rearrangement of the material, with additions and amplifications (including charts showing the brightest stars of the constellations) and a removal of the errors and least satisfactory features of the original.

"The Earth and the Stars" was reviewed in NATURE as an essentially good book, marred by looseness in construction and details of presentation. It is very pleasing to find that the defects have now been almost, if not entirely, eliminated, and we have no hesitation in recommending the present volume as a very valuable addition to the growing mass of astronomical literature. The text is enriched (the authors, with an excess of modesty, say "relieved") by a number of relevant and well-chosen anecdotes which accord well with the general tone of the book. It is to be hoped that it will circulate widely amongst those whose interest in impersonal and super-mundane things is waiting to be aroused.

For the sake of future editions, it may be well to point out the more important of the few errors and defects which have been noticed. It was Newton, and not Fraunhofer, as stated on p. 22, who introduced the slit into spectroscopic work. The diagram on p. 57 is ineffective, because of the small scale on which the earth is drawn. The account, on p. 241, of the process of emission and absorption of light (taken over from the earlier book) is so vague that it is difficult to believe that it would be intelligible to anyone not previously familiar with the Bohr model. The definition of the chromosphere (p. 148) as the whole atmosphere of the sun, including the reversing layer, is discordant with history, etymology, and general usage. Finally, the angstrom is not one ten-millionth of a metre, as stated on p. 221, but one ten-thousand-millionth.

The book is well printed and produced, though it has the excessive weight characteristic of many modern American scientific works. H. D.

Biology.

Shell Life: an Introduction to the British Mollusca. By Edward Step. New and revised edition. Pp. 421 + 32 plates. (London and New York: Frederick Warne and Co., Ltd., 1927.) 7*s.* 6*d.* net.

THE new edition of Mr. Edward Step's "Shell Life" is very attractive with its many delicately coloured plates. It is a popular account of all common mollusca, marine, fresh-water, and land, of Britain, and not only the shells but also the animals are described with notes on their habits. It is admirably fitted for its purpose—to introduce those who have no scientific training to the delights of collecting and observing one of our most interesting groups of animals, but we cannot help wondering whether the author's way of coining popular names whenever possible for even the rarer shells is really the best way. Such names as the 'peppery furrow-shell,' 'Turton's weasel-eye,' 'despised eolis' and 'least whelk,' do not, we think, really appeal to the lay mind more than the scientific names, even though based on these. Moreover, they have no meaning for anyone other than British, whereas to know the scientific name at least puts one in touch with foreign correspondents. However, as the scientific names are always added, this is a small matter.

Of more importance is the fact that *Littorina littorea*, the common periwinkle, is still stated to lay its eggs in a gelatinous mass on seaweed. This statement was fully accepted in 1901, the date of the first edition, but Dr. Tattersall in 1908 read a paper before the British Association showing that our three common periwinkles, *L. littorea*, *L. obtusata*, and *L. rudis*, are all different, *L. littorea* laying single egg capsules capable of floating, shaped like a soldier's tin hat and enclosing one or two, rarely three or four, eggs, which hatched as early veligers, *L. obtusata* laying eggs in a gelatinous mass on sea-weed (similar to Mr. Step's figure which he attributes to *L. littorea*), and *L. rudis* being viviparous.

The author's suggestion that *Solen pellucidus* is very likely only a variety of *S. siliqua* cannot be correct. Study of its life and habits and observations on the young of *S. siliqua* amply prove them to be separate species. With regard to the pteropods, British species are still stated to be rare, although *Limacina retroversa* is taken in enormous numbers in plankton round our coasts, forming a very important fish food; *L. Lesueuri*, which is not mentioned, has also been recorded both for the Channel and the North Sea.

Popular Handbook of Indian Birds. By Hugh Whistler. Pp. xxiv + 438 + 17 plates. (London and Edinburgh: Gurney and Jackson, 1928.) 15*s.* net.

THE present volume has been written by Mr. Whistler, but its issue is due, mainly, to the generosity of Mr. W. S. Millard, assisted by Mr. W. F. Mitchell and Sir George Lowndes, whilst it is due to these gentlemen also that the work is now purchasable at a price so far below its real value.

A book on the common birds of India is one which has for very long been a *desideratum*, and though several authors, amongst others Inglis, Finn, and Dewar, have written accounts of certain classes of birds, there has been no book to which a visitor to India could turn when desirous of ascertaining the names and habits of the birds he sees during the course of his travels in India.

This work very largely meets the needs of the traveller in India, but it certainly caters for the visitor to north-west and western India, rather than for those who may chance to visit other portions of that vast Empire. The author's personal knowledge of birds is obviously confined to the birds of the Punjab and North-West Provinces. So long as he writes about these birds he is able to be both scientifically correct and also very interesting. When, however, he writes about birds from other provinces, which is seldom the case, he has not the same grip of his subject.

Despite the above shortcomings, Mr. Whistler's work is undoubtedly the best and most comprehensive popular work on Indian birds that has yet appeared and should be of the greatest help to anybody who wishes to know more about the common birds he sees every day in India. In his preface, Mr. Whistler gives us his ideas on classification and some other points which are, perhaps, quite unnecessary in a work of this character. On the other hand, his comments on the points on which further information is still desirable are quite good.

The get-up of the book is excellent, and both the colour plates and woodcuts quite up to the high standard of all Mr. Gronvold's work. We regret that the publishers have found it necessary to use such heavily loaded paper, as the weight of the book makes the reading of it to be literally no light task.

Seashore Animals of the Pacific Coast. By Prof. Myrtle Elizabeth Johnson and Harry James Snook. Pp. xv + 659 + 12 plates. (New York: The Macmillan Co., 1927.) 32*s*. net.

This book, as the preface tells us, is a non-technical, illustrated account of the structure and habits of the common seashore animals of the west coast of the United States, and it will certainly be a great help to all those interested in shore collecting.

Two things strike the British zoologist about the Pacific fauna: the first is the general similarity to one's own common sea-shore animals, the second the decided differences, for there is really scarcely any common animal of the same species in the two regions. In general agreement are the jelly-fishes, hydroids, starfishes, and sea-urchins, anemones in the rock pools, limpet-like flat mollusks on the rocks, and other gastropods, sand-dwelling bivalves and other numerous sand- and mud-dwellers, but look into these carefully and great differences are seen. There is not one true limpet (*Patella*) mentioned, its place apparently being taken by the more primitive *Acmœa*, and by *Fissurella*, which has its headquarters in those parts; the periwinkles, top-shells, and whelks are all different species, and the same applies to most of the other animals. There are naturally some outstanding differences. A shore characterised by the beautiful 'sea pansy' in the rock pools and by the egg case of *Argonauta* (the Argonaut 'shell') cast up on the beach, is an altogether desirable collecting ground and one looked upon with envy by the Briton who hopes to go there some time.

Altogether an extremely good idea of the shore fauna is given and most of the illustrations are excellent, especially the photographs from life and some outline drawings, such as an atlantid on p. 527 and a diagram of *Tethys* on p. 488. The coloured plates, although giving a good idea of the brilliancy of many of these creatures, are not so well drawn as most of the uncoloured figures.

The authors rightly emphasise the desirability of the living animal being studied and if possible not preserved at all, whilst if aquaria are kept they should have few inhabitants.

A Glossary of Botanic Terms: with their Derivation and Accent. By Dr. Benjamin Daydon Jackson. Fourth edition, revised and enlarged. Pp. xii + 481. (London: Gerald Duckworth and Co., Ltd.; Philadelphia: J. B. Lippincott Co., 1928.) 15*s*. net.

The late Dr. Daydon Jackson was engaged in the revision of the proofs of this book in its fourth edition at the time of his death. His last contribution to the science that he loved will be of permanent value, and it is to be hoped that in future years some other botanist will continue this valuable work, and that the "Glossary of Botanic Terms" may long be available to smooth the path of the reader who would grapple with the terminology of a very descriptive science.

In the present edition the original pages are reproduced by photo-zincography. There are sixty additional pages of new terms, the results of the sometimes misplaced ingenuity of the botanical writers of the last decade. A list of commonly employed signs and abbreviations follows, and the work terminates with a bibliography of other books of a similar category.

Topographical Anatomy of the Dog. By Dr. O. Charnock Bradley. Second edition. Pp. xii + 268. (London and Edinburgh: Oliver and Boyd, 1928.) 24*s*. net.

Prof. Charnock Bradley's excellent manual, "Notes on the Dissection of the Dog," has now grown into an important treatise on canine anatomy, which is not only of interest and value to the veterinary student and surgeon, but also to medical and science students. It is a valuable work of reference to the comparative anatomist.

Chemistry.

Anorganische Chemie. Von Prof. Dr. Robert Schwarz. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, Herausgegeben von Dr. Raphael Ed. Liesegang, Band 16.) Pp. xi + 139. (Dresden und Leipzig: Theodor Steinkopff, 1927.) 8 gold marks.

In this little work the author has attempted to sketch the most important advances made during the years 1914–25 in inorganic chemistry. Since separate volumes in the series deal with the closely related branches of physical chemistry, physico-chemical mineralogy and petrology, colloidal chemistry and atomic structure, and others are to follow on metallography and inorganic chemical technology, attention has been mainly directed to experimental work on the preparation and properties of the elements and their compounds.

A short introductory section deals with the discovery of new elements by means of X-ray spectra, views on the composition of the earth's interior, molecular structure and its relation to the colour of inorganic substances, and with the classification of metallic hydrides. The elements are then all briefly reviewed in the usual groups, nitrogen, silicon, and sulphur being rather more fully noticed than any of the others. Thus the complex acids derived from sulphur, and from sulphur and nitrogen, are described, and also the application of Werner's theory to the structure of complex silicates. Many of the common elements, on the other hand, have received very scant attention. The last section of the volume is concerned with the developments arising out of Werner's work on co-ordination compounds of various types.

Selection of the material is necessarily very difficult, and naturally a large amount of attention has been paid to German periodicals, but there are also frequent references to English, American, French, and Italian publications, and the volume will be found to form a readable and useful supplement to the standard text-books.

Reaktionskinetik gasförmiger Systeme. Von. C. N. Hinshelwood. Übersetzt und erweitert von Dr. Erich Pietsch und Dr. Gertrud Wilcke. Pp. xii + 246. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) 16 gold marks.

English chemists will be glad to see that Mr. C. N. Hinshelwood's admirable book on the "Kinetics of Chemical Change in Gaseous Systems" has now been made available to a larger public by the appearance of a German translation. For the most part this translation follows the English text exactly, but the appendices to the English edition have now, with advantage, been incorporated into the body of the book. Further, the translators, with the consent of the author, have introduced a certain amount of new matter dealing with recently published results, but in doing so have been careful to leave unimpaired the original method of treatment.

The book has been made more valuable by the inclusion of a classified index (thirty-nine pages) of the most important gaseous reactions of which the reaction kinetics have been investigated. Under each reaction an alphabetical list of authors, with references, is given, and there is further a section (thirteen pages) containing references to papers "of general and theoretical importance." This index, evidently the product of much painstaking work, is itself a contribution of no small value to the literature of the subject, deserving the attention of all who are interested in the problems of reaction kinetics.

The format of the German edition, though inferior to that of the original, is not unsatisfactory, and the figures and formulæ are clearly set out. Drs. Pietsch and Wilcke are to be congratulated on the production of a worthy translation of a notable book.

A Text-book of Inorganic Chemistry. Edited by Dr. J. Newton Friend. (Griffin's Scientific Text-books.) Vol. 10: *The Metal-Ammines.* By Miss M. M. J. Sutherland. Pp. xxv + 260. London: Charles Griffin and Co., Ltd., 1928.) 18*s*. net.

The appearance of a separate volume on "The Metal-Ammines," in Friend's "Text-book of Inorganic Chemistry," suggests the prospect of a book of marked individuality, dealing with one of the most exciting sections of modern inorganic chemistry. This prospect has not been realised, since the text of Miss Sutherland's volume contains even less readable matter than the average of this series.

The book contains three introductory chapters, covering about 28 pages, but even these show a singularly poor response to the inherent interest of the subject, and, with the exception of a page on the electronic theory, they might all have been written during the confused pre-War period, when even Werner himself did not appear to be sure whether principal and subsidiary valencies are identical or different. It is indeed almost a *reductio ad absurdum* that the author gives more space to the cyclic formulæ suggested by the editor in 1908 than to the whole of the modern work on valency. The remaining seven-eighths of the book are occupied by a catalogue of ammines arranged according to the periodic classification, but here again the pre-War character of the text is shown by the fact that the index contains no reference to any of the poly-ammino-compounds described by Pope and Mann in a series of papers from 1924 onwards.

The book can, however, be commended without hesitation as a compendium of the earlier literature, summarised from the view-point of the earlier period, and entirely unspoiled by any electronic heresies.

Engineering.

Engines: a Book founded on a Course of Six Lectures (adapted, in the old phrase, to a Juvenile Auditory) delivered at the Royal Institution of Great Britain. By Dr. E. N. da C. Andrade. Pp. xv + 267 + 36 plates. (London: G. Bell and Sons, Ltd., 1928.) 7*s*. 6*d*. net.

Prof. Andrade's book is founded on the Christmas lectures delivered by him at the Royal Institution last year. Not a little difficult is it for the author of such a work to decide just how far to go in the development of his subject. It is clearly necessary, after the broad principles have been carefully enunciated, to show how they are applied in actual engines, and since they are applied differently in different types of engine, it is obviously necessary to trace the operative principle in each type. This is very effectively done without any suggestion of over-development.

There are one or two misstatements of fact which might be put right in a new issue. For example, it is unfortunate that the impression should be given that practically all marine boilers are of the water-tube type, particularly at a time when attempts are being made to overcome the difficulties associated with the use of water-tube boilers on ships. Again, it is suggested that in a De Laval turbine nozzle the divergence at outlet determines the pressure drop, whereas it is merely provided to improve the efficiency, and the pressure drop is determined by the area of the throats of the nozzles of the successive stages. Nozzles with no divergence at outlet are quite commonly used in pressure compounded impulse turbines for velocities greater than the velocity of sound; in such cases the steam jet diverges after leaving the nozzle.

Most of the great men in engineering are given due credit for their work, but in the turbine section Rateau is surely as much entitled as De Laval and Curtis to be mentioned with Parsons. Yet he is not even referred to; the credit for his work is given to Curtis, and a Curtis-Rateau or pressure compounded impulse turbine is inadvertently described as velocity compounded, whereas this description applies only to the first of its several stages. These, however, are merely the slips which appear to be inevitable, and they do not in any way affect the fundamental facts with which the book sets out to deal. It is an excellent work and should prove a valuable asset to those responsible for the early education of engineers. L. M. D.

Steam Condensing Plant: a Brief Account of the Construction and Principles involved in the Design of Steam Condensing Plant. By John Evans. Pp. xii+202. (London: Sir Isaac Pitman and Sons, Ltd., 1928.) 7*s.* 6*d.* net.

As the sub-title indicates, this book is intended for those "engaged in Installing, Maintaining, or Operating Steam Power Plant," and to such it should prove invaluable. It is of no particular value, except perhaps as a convenient handbook, to the designer or the theorist, and for the purpose for which it is intended this is perhaps its most valuable characteristic. The amount of theory used in the descriptive matter has been kept down to a minimum, consistent with the necessity for the reader to understand the functions and factors which affect condenser performance, and the theoretical explanations given are so lucidly expressed that they are quite easily understood by those unskilled in the technical treatment of engineering problems.

The order of work is well arranged. The functions and desiderata of condensers in general are first dealt with, after which the various types of condenser are classified. The types are then separately treated in detail in their proper order of importance, namely, surface, jet, ejector, and evaporative. This separate treatment is brief but concise and none of the rudiments escape attention, while space is found for some excellent descriptive illustrations and sketches of the commercial products of some of the best manufacturers. In each case the advantages and disadvantages of the type, as compared with the others, are set out clearly, and the general outlines of a design for certain specified conditions are given. A chart showing the maximum economical vacuum for given cooling water conditions, and an investigation of the causes of failure of a condenser to maintain the designed vacuum, are exceedingly useful sections. Air pumps, sometimes erroneously styled auxiliaries to condensers, are very properly treated as fully as condensers themselves, and feed systems, deaerators, etc., and cooling towers, spray ponds, etc., each receive appropriate attention.

For its size the book contains a wonderful lot of useful matter, and there is probably not a single paragraph which could be excised to advantage.

L. M. D.

Practical Radio Telegraphy. By Lieut. Arthur R. Nilson and J. L. Hornung. Pp. ix.+380. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 15*s.* net.

This book is written for radio students who are preparing to become radio operators. Very little knowledge is presupposed and we were impressed with the care the authors take to explain elementary electrical principles, so that when the student comes to radio circuits and apparatus he can readily obtain a good knowledge of how they work. It is a good handbook from which to train elementary students, and should also prove useful to operators who have to work standard American equipments.

Previous to the War it was the custom to use sparks for radiotelegraphic transmission. After the War the trend of design was towards vacuum tube and arc equipments. Hence many of the textbooks written in the early days are of little use to those who have to operate modern equipments. Again, in 1918, when broadcasting began to be considered as a commercial proposition, many books appeared describing receiving and transmitting sets, but entirely neglecting to explain radiotelegraphic apparatus. This book, therefore, will be welcomed by all—and especially by those with scant technical knowledge—who desire to qualify as radio operators.

In arc radio transmission the carbon electrode burns away very slowly, as it burns in a closed chamber containing hydrogen gas. The hydrogen gas for the arc is obtained by the decomposition of alcohol, which is fed into the chamber drop by drop and is vaporised by the intense heat of the arc between the copper and carbon electrodes. In the last chapter a good description is given of the radio compass which enables the navigator to locate the position of radio beacons. Light and sound signals are both very untrustworthy in foggy weather. Had this device been invented fifty years ago, many thousands of lives and millions of pounds would doubtless have been saved by its use.

Geography and Travel.

(1) *India by Air.* By the Rt. Hon. Sir Samuel Hoare. Pp. xix+156+24 plates. (London: Longmans, Green and Co., Ltd., 1927.) 6*s.* 6*d.* net.

(2) *Il mio volo attraverso l' Atlantico e le due Americhe.* Per Francesco de Pinedo. Con un proemio di Gabrielle d' Annunzio. Pp. vi+27+281+130 tavole. (Milano: Ulrico Hoepli, 1928.) 48 lire.

(1) Successful long-distance flights are becoming so numerous that the habit of writing a book descriptive of each must soon end. Except for the technical details of flying, there is a great deal of sameness about such books, although the aerial views are always of interest. Five de Havilland aeroplanes were ordered for the new service between

Cairo and Karachi. Sir Samuel Hoare took passage in the first and flew from Croydon *via* Italy, Malta, Tripoli, Egypt, and Basra to Delhi and the north-west frontier, and then back to Egypt. The journey from England to Delhi was 6005 miles and occupied 62½ flying-hours in eleven days. The book is a bright account of his and Lady Hoare's experiences on a journey which, though mainly uneventful, made history in air communications.

(2) The journey of Col. F. de Pinedo was longer and more eventful than Sir Samuel Hoare's. With two companions he flew from Italy, *via* Morocco and West Africa, across the Atlantic to Brazil and Buenos Aires; thence he crossed the Amazon basin to Para, and *via* Hayti and Cuba reached New Orleans. In Arizona his machine, *Santa Maria*, was accidentally destroyed; but he sent to Italy for a duplicate, and flew from New York *via* New Orleans to Chicago, Quebec, Newfoundland, and then home *via* the Azores and Lisbon. It was a fine achievement, and is described in detail in a beautifully illustrated volume.

The Open-air Guide: for Wayfarers of all kinds. By John R. Ashton and F. Arnold Stocks. Pp. 209. (Manchester and London: John Heywood, Ltd., n.d.) 3*s.* 6*d.* net.

THE authors of this pocket volume have gathered into a small compass a great deal of information which should prove of value to boy scouts, girl guides, and other campers and country wanderers. The chapters are suggestive rather than exhaustive, and some compensation for their brevity is to be found in the short bibliographies attached to each. The sections on weather lore, map reading, and the history of roads are among the best. Those on the geological features of scenery and on wild flowers are too condensed to have great value. There are useful sections on camp equipment and on first-aid. Figures of architectural types are well drawn, and there is a folding map showing places in England and Wales held by the National Trust.

The book is a sign of the growing interest in the countryside, not only on the part of motorists but also by walkers and campers. It is to be hoped that this interest will help to guard the scenic beauties of the country from devastation at the hands of builders and road-makers.

Seaways and Sea Trade: being a Maritime Geography of Routes, Ports, Rivers, Canals and Cargoes. By A. C. Hardy. Pp. xi + 240 + 14 plates. (London: George Routledge and Sons, Ltd., 1927.) 15*s.* net.

THERE is much valuable geographical matter in this book, much that is overlooked in the orthodox volumes on commercial geography, but it is too incomplete to merit its sub-title of a maritime geography. Routes are fairly well treated, and so are canals, but the chapters on cargoes and ports are far from complete. That is a pity, for the author knows his subject and writes in a fresh and interesting style. A book of twice the length would have proved readable even to those who find that commercial geography is generally dull. Every chapter is full of interest and well illustrated. The book treats the geography of trade from an angle that is too often overlooked. It should find a place in all school libraries, where its popularity would be assured.

Geology and Mining.

Clays, their Occurrence, Properties and Uses: with Especial Reference to those of the United States and Canada. By Prof. Heinrich Ries. Third edition, revised and enlarged. Pp. vii + 613. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 35*s.* net.

WHEN a book by an authoritative writer like Prof. Ries reaches its third edition, the task of a reviewer is usually little more than to indicate to what extent it has been brought up-to-date, and what important changes (if any) have been made either in the subject-matter or its treatment.

Some conception of the additions may be gathered from the fact that the first edition, published in 1906, had only xvi + 490 pages against the vii + 613 pages of the present issue (the latter having a contents table of one page preceding the text, instead of the more elaborate contents table, with list of illustrations, etc., of the earlier edition). Moreover, the sections on methods of mining clays and methods of manufacture, occupying 77 pages in first edition, have been omitted, so that the *new* matter in the third edition amounts to about 200 pages as compared with the original issue. The extra material includes a new chapter dealing with Canadian clays, and a section on bentonite, but the main portion results from the embodiment, in the text, of the more important facts accumulated respecting clays within comparatively recent years. Copious references to original sources are distributed through the book.

As might be expected, in dealing with such a vast amount of recent literature, some omissions are discoverable; nevertheless it may safely be said that Prof. Ries has produced a work which will remain the most valuable book of reference on clays generally for years to come. Though American and Canadian clays have received special attention, it should be understood that clays of other countries have been by no means neglected.

Der Bewegungsmechanismus der Erde dargelegt am Bau der irdischen Gebirgssysteme. Von Dr. Rudolf Staub. Pp. viii + 270. (Berlin: Gebrüder Borntraeger, 1928.) 18 gold marks.

THIS interesting book is a speculative discussion of the causes of motion of the earth's crust, which have led to great foldings and mountain building, and also, according to opinions to-day widely current, to large relative displacements of the continents. The discussion is from a purely geological viewpoint, and is entirely non-mathematical. It would appear from the bibliographical index that the author is not acquainted with so important a work, closely bearing upon his subject, as Jeffreys' recent book, "The Earth." The author's conclusion is that the two primary causes of relative motion of the earth's outer layers are a tendency of the uppermost layers towards the equator, and of the subcrustal layer to flow polewards; on the second of these he differs from Wegener, who postulated a westerly drift of the continents as the cause co-operating with the drift towards the equator.

Tin Mining: a Complete Guide for all Actively Interested or Engaged in Tin Mining. By C. G. Moor. Pp. xi+171. (London: Sir Isaac Pitman and Sons, Ltd., 1928.) 8*s.* 6*d.* net.

The sub-title to this book describes it as a complete guide for all actively interested or engaged in tin mining. In the introduction the book is stated to have been designed to help the practical miner and those investing in tin-mining enterprises. Actually, it is a book treating principally of alluvial tin mining and well suited to enlighten the working miner and the layman on the general aspects of that most important branch of tin mining. It is written in a lucid and fluent style; the type is clear and the format of the book is good.

While, therefore, it can be recommended to those desiring to have some broad knowledge of the subject, it is not written for the mining engineer. It includes no mining plans nor lay-out of areas; there are no drawings of dressing machines; the only illustrations in the book are photographs of tin mining in the Straits, and even these are not referred to in the text.

Medical Science.

Food Infections and Food Intoxications. By Prof. Samuel Reed Damon. Pp. viii+266+18 plates. (London: Baillière, Tindall and Cox, 1928.) 18*s.* net.

The author has divided the contents of this book into sections comprising (1) infections from food, (2) intoxications from food, (3) zoo-parasitic infections acquired through food. The section which deals with food infections includes not only food poisoning due to the Salmonella group of bacteria, but also infections such as *B. tuberculosis*, *B. melitensis* (undulant or Malta fever), *Streptococcus epidemicus* (septic sore throat), and the ray fungus (actinomycosis). This must be regarded as a somewhat arbitrary list, which, if it includes actinomycosis and septic sore throat, might equally well have been extended to include infections by *B. diphtheriæ*, *B. typhosus*, and *B. dysenteriæ*, all of which are in greater or less degree conveyed by food and drink. No mention is made of the possible transmission by milk of the *B. abortus* of cattle and the illness which it causes in man, though the author refers to the close relationship which exists between this organism and the virus of undulant fever, *B. melitensis*.

Under food intoxications, those toxins are described which are associated with *B. botulinus* (botulism), mushrooms, fish (certain organs of certain fish at certain times, and fish that are infected with bacteria pathogenic for man), grain (ergotism and lathyrism), potatoes (the alkaloid, solanin, occasionally present in increased amounts), and milk. This last is an interesting case of intoxication at second hand. It is caused by drinking the milk or eating the flesh of cattle which have themselves been poisoned by feeding on certain poisonous plants, particularly white snakeroot (*Eupatorium urticæfolium*) and rayless golden-rod (*Aplopappus heterophyllus*); it occurs in certain areas of the southern and mid-western States of America, though much less frequently than formerly.

The etiology, symptomatology, diagnosis, treatment, and prophylaxis of each infection or intoxication are described and very useful lists of references appended, though much recent work on the Salmonella group of bacteria has been disregarded.

H. S.

Pharmacognosy and Materia Medica: for Students in Pharmacy and Practising Pharmacists. By Prof. Homer C. Washburn and Walter H. Blome. With a Chapter on Vitamines and one on Insulin, by Water Pitz. Pp. xiii+585. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 25*s.* net.

'Materia medica,' in the conventional sense in which the term is used in this book, means knowledge of the diagnostic characters of natural drugs of botanical or zoological origin. In these days, when the factory has largely replaced the individual craftsman in the art of converting crude natural drugs into medicinal preparations, such knowledge is rarely required in practice, from either the medical man or the pharmacist, and it has been urged that this position should be recognised by appropriate changes in this branch of pharmaceutical education. Moreover, 'Materia medica,' as a subject in a course of pharmaceutical training, still includes many natural drugs, which have, or should have, ceased to interest orthodox medical men, except perhaps as items in the history of medicine, and on this ground also there is room for reform of the kind just indicated.

The book under review is well written on what are now almost classical lines for such literature, but it does show some modernist tendencies. Thus it devotes separate chapters to vitamins and insulin, and though the section on animal drugs includes musk and leeches, it does also deal with antitoxins, epinephrine, and thyroxine. But until educational authorities change their conception of 'Materia medica' to something more akin to the range of chemical and biological materials actually used in medicine to-day, little change can be expected in books of this character. Even now, however, pharmacognosists might impart more living interest to their textbooks by being more critical and more explanatory in regard to the chemistry of natural drugs. In the present instance, for example, the paragraphs headed "Constituents" throughout the book would gain enormously in interest and value by revision and extension by a competent and critically minded chemist.

Ultra-violet Rays in the Treatment and Cure of Disease. By Percy Hall. With introductions by Sir Henry Gauvain and Leonard E. Hill. Third Edition. Pp. xviii + 236. (London: William Heinemann (Medical Books), Ltd., 1927.) 12*s*. 6*d*. net.

BOOKS which are read by medical readers often leave a good deal to be desired when regarded from the scientific point of view, and this is so in the book in question. A large amount of information on the types of lamps suitable for ultra-violet treatment is collected together, but a practitioner wants more than this; he naturally looks for information on the difficult subject of dosage, and the author might well try to give more definite information here.

The author is apparently under the impression that from the tungsten arc, rays are emitted which cannot be detected by any modern spectroscope or other instrument. Few physicists will agree with him, and still less with his assumption that the ultra-violet rays of the fifth octave (beyond the visible) are not less, but more, penetrating than those of the first octave. Perhaps some revision of an assumption contrary to all experimental facts may appear in a book which in many respects serves the purpose for which it has been written.

An Elementary Text-book of General Microbology. By Prof. Ward Giltner. Pp. xvi + 471. (London: J. and A. Churchill, 1928.) 15*s*. net.

As its title states, this book is devoted to a general discussion of the science which the author curiously renames "Microbology," insisting that this word means "the biology of the small forms of life," whereas "Microbiology," in his opinion, only stands for "small biology"!

Written in a clear and interesting manner, the book deals with the lower forms of life represented by the yeasts, moulds, protozoa, bacteria, and ultramicroscopic viruses, describes their biology, their intentional and unintentional participation in various branches of industry (dairy products, preserved foods, fermentations, etc.), their occurrence and significance in air, water, soil, and sewage, and their association with disease in the animal and plant world.

In no way a textbook for those specialising in any of these subjects, it gives a survey of the whole field in a manner that is readable, complete, and concise. The terminology is that adopted by Bergey and a certain section of American bacteriologists. H. S.

Miscellany.

Inventions and Patents: their Development and Promotion. By Milton Wright. Pp. vii + 225. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 12*s*. 6*d*. net.

FROM the days of Jabal, Jubal, and Tubal-Cain people have been engaged in producing articles, both useful and ornamental—articles of necessity and luxury; and we are all (with rare exceptions) interested directly and indirectly in inventions, either as inventors or as benefiting by the ingenuity of others. Where the present is in advance of the past is in the protection afforded to those who desire to receive for a period the pecuniary reward attaching to their inventive powers. Naturally, the patent laws of different countries exhibit certain variations, but there is more than a mere family likeness pertaining to them in common. Mr. Milton Wright, in his book on "Inventions and Patents" writes as an American under the U.S.A. law, but his book is both interesting and valuable to citizens of other States. It may be added that one chapter is devoted to the rights as existent in the various countries. He quotes the saying of an inventor, adapted from a dictum of Thomas Edison's, that a successful invention is 2 per cent inspiration and 98 per cent perspiration, which crystallises the view that genius unallied to industry cannot hope to succeed. Of the twenty-three chapters, those containing "Don'ts" and answers to questions are not the least interesting; but from cover to cover the book merits careful reading and a place on one's bookshelf for the purposes of handy reference. P. L. M.

The Romance of English Trading. By S. A. Williams. Pp. 211. (London: University of London Press, Ltd., 1928.) 2*s*. 9*d*.

THIS volume tells how the people of Great Britain, from the Middle Ages to the present day, have obtained the necessaries of life. Chapters are devoted to fairs and markets; the rise of sea-trading; the great trading companies; roads and canals; and trading in the railway age. The text affords evidence of wide and recent reading, careful sifting of what has been gleaned, and attractive presentation of the subject-matter. The illustrations are well chosen. The author is the principal of a day continuation school, but the book will appeal to a wider public than that for which it was obviously written.

In a new edition it might be emphasised that the right to hold a market was a privilege obtained from an overlord and jealously guarded. More stress might be laid on the gild system and the fact that the merchant gild antedated the craft gild. The constitution of the joint-stock company of the eighteenth century as compared with that of to-day should be made clearer. The very small tonnage of early merchant vessels is not brought out as it should be. H. W. D.

Pioneers of Invention. By William and Stella Nida. (Harrap's Readers of To-day.) Pp. 189. (London, Bombay, and Sydney: George G. Harrap and Co., Ltd., 1927.) 1*s*. 6*d*.

THE attempt to cover the story of invention in applied science, as is done in this volume, within the compass of 188 pages, is almost bound to fail, unless made by one who is expert in each separate invention. The severe condensation necessary leads either to a bald catalogue of facts or, if the attempt is made to be interesting, then to generalisations that are too sweeping, or to emphasis on the striking rather than the important, or even to statements that are actually misleading. As an example, we may cite the generalisation on p. 57, in speaking of Eli Whitney: "Standing behind every inventor we find a benefactor who, with friendship or money, has helped him to succeed." A misleading statement is that on p. 44, to the effect that George Stephenson built *Puffing Billy*. Success or failure of an invention turns frequently on small practical difficulties, and it is too much to expect that a single author can be cognisant of all these minutiæ. H. W. D.

Psychology.

Common Principles in Psychology and Physiology. By Dr. John T. MacCurdy. (The Cambridge Psychological Library.) Pp. xvii + 284. (Cambridge: At the University Press, 1928.) 15*s*. net.

THIS book is a striking addition to the 'worth-while' books on the functions of the nervous system. It is, however, a difficult book to read, as the author quite candidly admits in his preface. The dominant theme of patterns is purely an abstraction and is an attempt to bring the material and the immaterial more into harmony with one another than is commonly done. Dr. MacCurdy confesses to being averse to materialistic hypotheses and takes up a position which is whole-heartedly immaterialistic. His theory is that all the processes of the mind, and indeed of the nervous system, are integrated, correlated, and controlled by what he calls 'patterns.'

The book is divided into two parts, the first dealing with psychology, the second with the physiology of the nervous system. At the end of each part is a summary of the application of the theory of patterns to these two branches of knowledge. Several of the chapters on psychology into which the author interweaves considerable portions of his very wide knowledge of abnormal psychology are extremely interesting and well-thought-out discussions—apart from any question of patterns. Altogether, an excellent presentation of a difficult subject and a book which requires to be read several times before the author's ideas can be adequately understood.

The Opposite Sexes: a Study of Woman's Natural and Cultural History. By Dr. Adolf Heilborn. Translated from the German by J. E. Pryde-Hughes. Pp. viii + 152 + 5 plates. (London: Methuen and Co., Ltd., 1927.) 6*s*. net.

THE author deals with the whole question of woman in three chapters, of which the first covers physical differences and the second the mental differences between the sexes. Current views are ably summarised. While accepting the position of the fundamental and absolute distinction of the two sexes and stating fairly the arguments for assigning woman an inferior or a superior position in the evolutionary scale, the author himself inclines to the former view. This comes out when he considers the development of the social position of woman. A concise historical survey, starting from the functional activities, pictures her social and economic progress as a gradual shackling of man, culminating in the 'feminism up-to-date' which has followed the War, in which, without stressing the point, he hints there is a message. The book, however, is written without bias as to fact and might serve either side of the argument.

A Synthetic Psychology: or Evolution as a Psychological Phenomenon. By Percy Griffith. Pp. xii + 214. (London: John Bale, Sons and Danielsson, Ltd., 1927.) 7*s*. 6*d*. net.

FOR an author to have to ask for faith, tolerance, and patience is in itself a warning of trouble to come. To claim ignorance of psychology as a passport to success in writing about it even as an amateur is giving the show away. To say that every mother can claim to know more about the psychology of children than all the psychologists put together is decidedly unreasonable. The author's hypothesis of 'mind in general,' which he splits up into 'mind-in-nature' and the 'mind of man,' must surely be held to be not proven.

Intelligence and Mental Growth. By Claude A. Claremont. (Psyche Miniatures, General Series, No. 13.) Pp. 138. (London: Kegan Paul and Co., Ltd., 1927.) 2*s*. 6*d*. net.

THE author has presented us with a very readable little book. He perhaps tries to make the subject of intelligence rather simpler than current opinion would justify. Intelligence is defined as the "power to become aware of the necessity of certain causal relationship." Whether the awareness of causation is exactly the same as intelligence is a matter of argument. However, Mr. Claremont is to be congratulated on a very refreshing presentation.

Psycho-Analysis for All: a Lecture delivered in Vienna. By Dr. Rudolf Urbantschitsch. Translated by Dr. Arnold Eiloart. Pp. 63. (London: The C. W. Daniel Co., 1928.) 2*s*. 6*d*. net.

A SIMPLE and very abbreviated account of psycho-analysis for the man in the street. The author gives a few illustrative cases, but does not go into any detail of theory. It will probably not convince the reader, but will make him want to know more of the rationale of the method.

Technology.

Grammar of Textile Design. By H. Nisbet. Third edition, revised and enlarged. Pp. xi + 553. (London: Ernest Benn, Ltd., 1927.) 32*s*. 6*d*. net.

THIS treatise is a standard work on woven fabric construction, and deals mainly with the technical part of textile design. The third edition contains a useful chapter on the decorative value of artificial silk, and the chapter on gauze and leno weaving has been augmented by descriptions and diagrams of American types of flat steel doups for heald and Jacquard harnesses.

Woven fabrics may be divided into three broad divisions: (*a*) fabrics constructed from some simple form of interlacing of the two sets of threads, *i.e.* warp and weft; (*b*) fabrics that have a foundation texture, but on one or both sides the surface is covered with loops or tufts—these are known as pile fabrics; (c) fabrics constructed by cross-weaving, that is, when the warp threads pass wholly or partially round each other, and thereby causing distortion and, in most cases, producing textures that are of an open character. The first 120 pages give all the standard forms of interlacings that are used for weaving the common classes of fabrics. Designs and photographs well illustrate the characteristics of each texture. The chapters on fustian and terry fabrics are very good, and these are typical pile fabrics. Unfortunately, structures for the pile fabrics produced with the aid of wires are not included.

An excellent chapter of 100 pages explains the principles of cross-weaving. These gauze and leno fabrics are not made in large quantities for the home trade; the cellular shirting is a simple type of this kind of cloth. The following chapters deal with specialised structures; for example, tissue, lappet and swivel, single and extra warp and weft figured brocades, damasks single and compound. Very good explanations are given in other chapters of the principal types of quilting fabrics, piqués, and matelasses, and the loom equipment required.

In another chapter descriptions are given of the tapestry styles; some of these structures are complicated, but they are developments of the simpler types. The last part of the book deals with the decorative value of artificial silk, and its reactions with dyes, and also comparisons with real silk. Practically every kind of structure is explained in this book, and it can be recommended to all those who desire to obtain a thorough understanding of fabric construction. J. M. E.

Defects in Glass. By Dr. C. J. Peddle. Pp. x + 205 + xiv + 17. (London: Glass Publications, Ltd., 1927). 8*s*. 6*d*.

In the old days the manufacturers of glass ranked among the most secretive in the whole range of industry. Recipes and processes were jealously guarded, and there was no attempt at interchange of views with regard to the common difficulties experienced more or less by all in the course of the manufacture. The exigencies of the War period brought about a salutary change in the outlook. The value of scientific investigation found recognition, and the inception of the Department of Glass Technology at the University of Sheffield resulted in the establishment of a permanent centre for research work on glass, whilst the formation of the Society of Glass Technology provided for the publication of valuable reports on original work.

The author of this book on defects in glass took a prominent part in glass research, both in the laboratory and in the factory, and his wide experience gives him exceptional qualifications for preparing such a work. The various defects are discussed in detail—more especially devitrification, but also bubbles, seeds, stones, etc.—and not only are the causes clearly explained, and suitable remedies suggested, but how to avoid the troubles is also pointed out.

The glass industry is fortunate in having at its disposal such reliable practical information supplied by an acknowledged authority. All connected with the manufacture of glass should find something of value and interest in the volume, and even users of glass would learn from it many important facts.

Cotton Spinning. By Thomas Thornley. (Intermediate or Grade II.) Fourth edition, revised and very greatly enlarged. Pp. ix + 502. (London: Ernest Benn, Ltd., 1926.) 25*s*. net.

The publication of this, the fourth edition of a work which has for twenty-five years received recognition as a standard treatise on cotton spinning, reveals a further revision and enlargement; the subject matter having been brought up-to-date in conformity with "Cotton Spinning: Elementary" and advanced "Cotton Spinning," which form parts of the same series.

The preparation of this treatise has been effected with the view of assisting all persons who, actively or otherwise, are engaged in the many branches of the spinning industry, and in this object the author must derive no small measure of success. The twelve chapters comprising the book contain some very interesting and practical information on all spinning processes, although a more definite sequence and manner of presentation in dealing with any one particular stage of treatment could be adopted with benefit to the general reader and student. Some of the subject matter, especially in Chapters ii., xi., and xii., could advantageously be omitted in favour of a more extensive treatment of other sections, notably those embodied in Chapters iii. and iv. The illustration of the text is well effected, whilst the miscellaneous calculations and data must prove of guidance to the student. In its present form, the volume is an excellent source of information in the field of cotton spinning, and should be found of valuable assistance. H. S.

Ceramic Tests and Calculations. By Prof. A. I. Andrews. Pp. viii + 172. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.)

This book contains carefully drawn up instructions for preparing test pieces, and for making the various tests, besides showing clearly how to proceed with the necessary calculations. Tests are given for raw materials, fired ceramic products, glazes, frits, enamels, and glasses. Apart from a very few rather loose statements—fortunately of minor importance—the explanations are clear, though generally brief; and the diligent student who makes good use of the examples given for exercise should find himself adequately equipped for dealing readily with most ceramic industrial problems involving calculations.

An appendix, comprising a number of useful tables to facilitate calculations, is followed by a good index. The book is well got up, and misprints are few and of little importance. American standards and tests are used exclusively. Some of these differ from those in general use in England, but anyone who understands either should find no difficulty in applying the other.

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was staged. Nobile had disappeared in the Arctic and half the governments of Europe were sending ships, ice-breakers, and aircraft to aid in the search for him. Amundsen believed that the Italians had treated him badly in the past, but the inherent greatness of the old idealist blazed out once more and he volunteered to lead a search party. On June 18 he left Norway in the large French Latham sea-plane piloted by Capt. Guilbaud, and manned by a crew of four. They disappeared to the northward; wireless signals ceased after a few hours, and only the discovery of one of the floats of the machine off the Lofotons points to the way in which this great Norseman met his end sweeping out on his last voyage like a dead sea-king of old in his funeral ship.

By his great two feats of navigating the North-West Passage and reaching the South Pole, Amundsen had brought himself into the front rank of explorers, and his books on these expeditions must remain classics. Through his last book, "My Life as an Explorer," we are admitted to a more intimate acquaintance than has been possible in the case of other explorers; but any glimpse of human weakness he gave in its pages must not be allowed to dim the greatness of his supreme foresight, fortitude, and success in discovery.

HUGH ROBERT MILL.

DR. ROBERT KNOX.

WE deeply regret to record the death of Dr. Robert Knox on Sept. 21, at sixty years of age. Knox was born at Leith, and obtained his medical education at Edinburgh and Guy's Hospital. After a short period of work in general practice he became definitely associated with the very young subject of medical radiology, and throughout the rest of his life we may say that he was linked with every important movement in this branch of medicine. With characteristic thoroughness his interests extended to every ramification of the subject; whether it was a question of hospital equipment or the association of the laboratory with clinical work or the status of radiologists, Knox would be found on the appointed committee, and he would be there in committee as member, secretary, or chairman. This went on for years, and until quite recently he appeared to carry the load lightly.

The societies and associations with which Knox worked, and by which his services were recognised in many very pleasant ways, were many. As secretary and then president of the Röntgen Society, he did splendid service during difficult years, and he finally supported its affiliation with the British Institute of Radiology, an institution he also helped to found.

Knox held important positions in the hospital world; he was at one time honorary radiologist to King's College Hospital, the Great Northern Central Hospital, Queen Alexandra Hospital, Millbank, and the Cancer Hospital, Fulham. It was at Fulham that his most important contributions to medical radiology were made. In radio-diagnosis Knox had a great eye to technique, and contributed much to the development of serial radiography and its application to the study of the heart in action; in radio-therapy he cautiously felt his way over many years in the treatment of cancer by X-rays, and, realising the danger of heavy doses to the skin in administering doses to the deeper structures of the body, he devised a method of rotational focus by which this danger was largely eliminated.

In view of the many other claims upon his time, Knox's writings were considerable; his book, "Radiography, X-ray Therapeutics, and Radium Therapy," appeared in 1915, and a second edition was quickly demanded, which led him to divide the book into two volumes, and this is now in its fourth edition.

Knox was well known and honoured in the radiological world; the American Röntgen Ray Society and the Scandinavian Röntgen Ray Society both elected him to their lists of honorary members. On the retirement of the late Dr. Deane Butcher, he became the joint editor of the *Archives of Radiology*, the name of which was years later changed to the *British Journal of Radiology*. His editorial colleagues will always remember how much Knox did for the old *Archives*. He won his way by sheer merit, and he was a man very much liked by his associates. Voluntary workers were always to be found in his hospital departments, attracted by the encouragement he gave them and by a friendship they rightly valued. S. RUSS.

THE sudden death of Dr. Stephanos Xanthoudides, announced in the *Times* of Sept. 21 by Sir Arthur Evans, is a blow to the archæologists not only of Greece but also of the whole world, who are indebted to him for his exertions in conjunction with Dr. Hatzidakis in instituting the Museum of Cretan Antiquities. It was outside this museum, according to Sir Arthur Evans's information, that his death took place. Although the museum at Candia represents his life work, he himself was an explorer and excavator of no mean achievement. His work on the vaulted tombs of Mesara in the south of Crete was an illuminating contribution to the history of the early culture of the island. He had also devoted himself to the exploration of its later history, and was an authority on its remains of the Byzantine Age. It is satisfactory to know that he had completed the reparation of the damage to the museum caused by the disastrous earthquake of 1926. His death will be a great loss to his many friends and fellow-workers of all nationalities.

WE regret to announce the following deaths:

Prof. D. Noël Paton, F.R.S., until recently Regius professor of physiology in the University of Glasgow, on Sept. 30, aged seventy years.

Sir Henry Wickham, who succeeded in obtaining seeds of *Hevea* from the Upper Amazon which were successfully grown at Kew and distributed in the East, thus starting the plantation rubber industry, on Sept. 27, aged eighty-three years.

News and Views.

A special general meeting of members of the Royal Institution will be held on Monday next, Oct. 8, when the managers will place before them several matters relating to the general position of the Institution and desirable alterations in the structure. The lecture theatre is now much out-of-date, partly on account of natural deterioration, but more particularly through the rise of the accepted standard. Considerable changes must be made in the structure, the seating, and the exits if they are to conform to the requirements which are now usual and are indeed enforced in the case of public buildings. A large sum of money would be required to carry out the re-arrangements and additions under consideration. The expense is not lessened by the determination, which the managers consider to be of the highest importance, that the historic rooms shall not be touched. The sum required is in the neighbourhood of £75,000. At the meeting on Oct. 8, the managers will ask for powers to proceed with negotiations and the preparation of detailed plans. These matters will be submitted for approval or rejection at a further meeting of members in November. There is, of course, the hope that by that time some friend of the Institution may have come forward to save the necessity for disposing on lease of any part of the building.

An observatory is being erected in Mill Hill Park to house the 24-in. reflecting telescope by Grubb which belonged to the late Mr. W. E. Wilson, F.R.S., of Darramona, Ireland, and was presented by his son to the University of London on condition that it should be adequately housed and maintained. The Hendon Urban District Council has provided the site, and provision will be made for the ratepayers to visit the observatory. Provision will be made at the new observatory for the accommodation of the 10-ft. Rowland grating at University College and a cœlostat by Cooke. A well-equipped workshop will be provided and a full-time mechanic appointed so that research apparatus may be made as required, and it is hoped that inventing and trying out new or improved observational methods will constitute one of the chief activities of the observatory. There are, however, several problems relating to the photography of nebulæ for which this instrument appears to be well adapted, such as making short exposures on nuclei of suitable non-galactic nebulæ in order to determine their precise positions relative to the stars, so that data may eventually be available concerning the possible rotation of the galaxy.

George Baxter was born at Lewes in 1804, and as a youth was engaged in the printing works of his father, John Baxter, as lithographer and engraver. At that time prints were sometimes coloured by printing, but the process cannot have been very successful though it had been practised for many years, for even large editions were being coloured by hand. In 1835 Baxter was granted his patent and says: "In order to produce a number of ornamental prints resembling a highly coloured painting, whether in oil or water colours, according to my inventions, I proceed first to have the design engraved on a copper or steel plate." This engraved plate gave the outline and the detail, and colours, chiefly (or only) in oil, were then applied by means of blocks. But the beauty of the prints, which are noted for their delicacy and brilliance, was not entirely due to the method. Baxter was an artist who could paint pictures; he was a practical printer and engraver; he knew what was wanted and had the skill and perseverance to get it. The famous print of Queen Victoria's coronation, for example, contains about 200 portraits, many made from the life by Baxter himself, and needed more than twenty printings to get the colouring.

The first books that Baxter illustrated were printed in 1834, when he resided in King Square, Goswell Road. In the following year he removed to 3 Charterhouse Square, and after nine years (1844) to 11 Northampton Square. His business prospered so that in 1851 he occupied No. 12 as well, and it was in these two houses that the bulk of the work by which he is known was done. His effects were sold by auction in 1860, and in 1867 he died. It seems rather strange that the London County Council, after consideration, concluded that so notable a pioneer and producer of printed colour pictures as George Baxter "was not of sufficient eminence" to justify marking with a memorial tablet the house in Northampton Square where he lived and worked, but it is satisfactory that Mr. E. Kilburn Scott and numerous subscribers have provided and fixed the tablet that was recently unveiled.

Lord Eustace Percy, the Minister of Education, on Wednesday, Sept. 26, opened the new Hastings Museum, which was a palatial residence built by a private resident, Mrs. Kidd, and sold very cheaply to the town by the owner. The configuration of the rooms lends itself to the display of objects illustrating the history of the town and East Sussex. Lord Eustace said that the value of museums, like the one at Hastings, the real significance of which people often forget, is that they are a sort of local visualised reference library of the arts and sciences, and therefore an essential part of national education. Museums represent something like a local college of learning to which the elementary and secondary school children may resort, so that study of the contents may lead to the realisation of the value of education throughout life. In fact a museum ought to be a centre of higher education and intellectual life. Dr. Bather, lately of the British Museum (Department of Geology), who was representing the Museums Association, put in a serious plea for the exhibition, not merely of antiquities, but of what people called 'bygone days.'

Our note on St. Fiacre (see "Calendar of Customs and Festivals," Nature, Sept. 1, p. 334) has stimulated Mr. G. M. Fraser, of the Public Library, Aberdeen, to contribute to the *Aberdeen Press and Journal* of Sept. 21 a well-informed article on this saint who, under the form of St. Fittack, is the patron of the church of the parish of Nigg, Aberdeen. Mr. Fraser is convinced of the Scottish origin of the saint, accepting Dunstaffnage on the coast of Argyll as his birthplace, at about the end of the sixth century. It is possible that this is correct, as this was an ancient royal seat, and after St. Fittack had settled in France he is said to have been visited by a deputation of chiefs and priests who wished him to accept the throne as a member of the royal line. The question is obscure, and it has to be remembered that in early records 'Scot' is usually to be taken to mean racially what we would now call Irish. Mr. Fraser points out that the various forms of the saint's name, which are many, are all derived from the Irish *fiach*, a raven. How the church at Nigg came to be dedicated to St. Fiacre is not clear, but Mr. Fraser suggests that his patronage of stocking-knitters is derived from his connexion with Aberdeen, as the art is said to have been introduced into France from Scotland. Owing to limitation of space our Calendar must necessarily pass over much that is worth noting. The life of St. Fiacre, apart from the association of his name with a Parisian public vehicle, has many points of interest to the folklorist, such as, for example, the recurrence in his relations with the Bishop of Meaux, *inter alia*, of the familiar story of a grant of such an amount of land as could be encompassed in a day, in which, once more, the beneficiary got the better of the bargain.

A SHORT account of personal recollections of Sir Richard Owen in the later years of his life appears in the *Victorian Naturalist* for July. The writer, Edward A. Vidler, a grandson of Dr. George Bennett, the Sydney naturalist, was then in his early twenties and paid regular visits in the middle 'eighties to Sheen Lodge, a comfortable and picturesque cottage in Richmond Park, where Sir Richard lived with his daughter-in-law and a maid-servant. Richard Owen, then about eighty years of age, is pictured as a man tall and thin, with big hands and feet, square shoulders, a large head, with a very prominent high forehead and very deep-set grey eyes, high cheek-bones, a long heavy nose with broad nostrils, very wide thin-lipped mouth, square chin, over which grew a long beard of black hairs so sparse that the contour of the chin was clearly visible, and long, thin, straight dark hair surmounted by a black skull-cap. He was, to the young man, a fearsome figure at first sight, but had an air of friendliness and gentleness the very antithesis of his outward appearance. Mr. Vidler's anecdotes of Sir Richard reveal him as the great investigator, sure of his ground, as a collector who showed with pride the gems of his collection, and as the possessor of that heavy type of humour which seems somehow to be characteristic of the man of science, though it is scarcely likely that even under its prompting the anatomist would hand his guest the vertebra of a whale in lieu of bread. The disc-like epiphysis alone would represent a mighty pancake! The photograph from the Vidler family album, reproduced in the short article, is an excellent and characteristic portrait of Richard Owen.

ZOOLOGISTS lament, and with some reason, the burden of scientific synonyms which gathers about certain well-known species. But scientific synonymy must take second place to the superfluities of popular nomenclature. Albert Wade has collected the local and general names which have been applied to salmon and sea-trout, and they number one hundred and thirty-six (*Salmon and Trout Magazine*). Even allowing that there are six well-defined life-stages in the history of a salmon, the superfluity is obvious. The great difference between scientific and popular synonymy, however, is that while the former represents some sort of imperfect identification, the latter generally stands for local idiosyncrasy. The list therefore would have been much increased in value had the author indicated the area in which each name was in common use.

THE new geyser which began erupting in Yellowstone Park early in August is described in a recent *Daily Science News Bulletin*, issued by Science Service, Washington, D.C., to be the greatest now active in the world, and with the exception of Old Excelsior, extinct since 1888, the greatest ever witnessed. The crater is elliptical in outline, 100 by 120 feet, and about 8 feet deep. The geyser suddenly bursts forth in furious and explosive activity, hurling water in all directions to an average height of 60 to 75 feet, with occasional spurts reaching as much as 100 feet. Outbursts occur at 15 or 20 sec. intervals, and continue for some three hours before the eruption abruptly comes to an end. Then follow nine hours or so of quiescence, during which the crater is dry except in a small fissure and several boiling mud-springs along the north edge. The action of the geyser is so violent, its eruptions so spectacular, and its periodicity so regular, that it is likely to become one of the Yellowstone's greatest attractions. A special road is now being constructed to make it accessible to the touring public. Of particular interest is the news that Dr. A. L. Day and Dr. E. T. Allen, of the Geophysical Laboratory at Washington, are conducting a thorough investigation of the phenomena. The former eruptions of the neighbouring Excelsior Geyser were not so frequent as those of the new geyser, and lasted only half an hour instead of three hours, but they were even more violent, throwing large masses of water from 100 to 200 feet in the air. In the late 'eighties the steam explosions so increased in power that the sinter encrusting the crater began to be torn off in jagged blocks. The geyser rapidly "erupted itself to death," and for nearly forty years its precipitous-sided pit has been occupied only by a hot seething lake.

THE Fabian Society announces a course of six lectures under the general title "Western Civilisation: whither is it going?" to be given in the Kingsway Hall at 8.30 P.M. on successive Thursdays, commencing Oct. 18. The lecturers and the special aspects of the subject with which each will deal are the Hon. Bertrand Russell (general); Mr. J. B. S. Haldane (science); Prof. C. Delisle Burns (labour); Prof. Ernest Barker (spiritual authority); Miss Rebecca

West (woman); Mr. Bernard Shaw (the future). Mr. Russell's syllabus opens with the provocative statements that western civilisation derives from four sources, Greeks, Jews, Romans, and science, and that the catholic church is a synthesis of the first three. In Mr. Haldane's view, western civilisation rests on applied science, and its future will depend largely on how science is applied to human life; and he will deal specially with socialists' 'reaction' to this thesis. Light on this question will also be thrown by Prof. Delisle Burns, who makes the reassuring announcement that "the contrast between an 'intelligentsia' incompetent with his hands, and 'labour' incompetent with its brain, is breaking down." Miss West will develop her view that the common lot of woman is persecution—in some parts of western civilisation by overwork, in the United States by underwork. Finally, Mr. Shaw, who will lecture last, will begin at the beginning by discussing the thesis that there is an entity to which the term 'western civilisation' can be applied. "To call these bungaloid promiscuities civilisations merely because they have all ceased to run out excitedly to look up at aeroplanes, and can argue about birth-control, is absurd."

STEADY progress is being made by the Imperial Geophysical Experimental Survey which is at work in Australia under an arrangement between the Empire Marketing Board and the Commonwealth Government. Mr. A. Broughton Edge, the leader, has visited several areas which, for various reasons, seemed likely to be suitable for the projected tests of geophysical methods. On his recommendation the executive body in control of the survey has authorised a commencement of work by the electrical methods at Anembo, an unworked metalliferous field about 30 miles from Queanbeyan, a town in New South Wales on the boundary of the Federal Capital Territory. The New South Wales Department of Mines has undertaken to test the conclusions of the survey by boring, if they appear to be sufficiently encouraging. In addition, gravimetric work has begun on a brown coal area near Gelliondale, in Gippsland, Victoria, which affords opportunity for useful examination of suspected faulting, while being, at the same time, suitable for certain necessary preliminary studies of the gravity balance under characteristic Australian field conditions. With the arrival of the deputy-leader, Dr. E. Bieler, of McGill University, Canada, in July, and the appointment of several Australians to junior positions, the personnel of the party is now nearly complete.

IT is not a simple matter to find mining fields ideally suitable for geophysical tests of the type desired. In most of the known fields the existing shafts, plant, railway lines, etc., introduce complications which it would be well to avoid in test experiments. Over immense areas the existence of underground saline waters, containing from one to five ounces of salts to the gallon, introduces a further difficulty that is rather typically Australian. Even more typical and likely at times to be somewhat annoying to workers on electrical conductivity is the common long rabbit-proof fence of wire netting, the bottom of which goes at least six inches into the ground. Attention is being given to the possibility of effectively applying geophysical methods to the discovery of underground water in a wide area of several million acres in the southern portion of Western Australia. This region is under consideration as one suitable for development under the migration agreement between Britain and the Commonwealth.

AT the time of the establishment of the Austrian Republic, although its area and population were each approximately one-quarter that of the old Empire, yet the home supply of coal was almost negligibly small. It was compelled, therefore, by sheer necessity, to develop as quickly as possible the water power that remained to the Republic. Luckily there were many Alpine lakes at a very high level which in 1918 had practically been unused for power purposes. With the help of about 30 per cent of the total capital required from foreign sources, building operations on at least 120 water-power stations have been begun since the War. The installed horse-power is now nearly a million, of which about two-thirds is in operation. The federated railways have four large hydro-electric stations which supply the western main lines. Upper Austria sends its surplus power to Vienna. Similarly Salsburg sends power to Bavaria. The new 220,000 volt line leading from the Alps to the Rheinische-Westphalia industrial districts has brought the question of the export of power to Germany more to the foreground. The possibility is thus opened up of transmitting power to the States to the north of Austria. One advantage of exporting power is that this is one of the few exports which is not burdened by those import duties generally imposed upon raw materials. About two-thirds of the total electric power used for industrial power purposes in Austria is obtained from water power. The Vienna electricity works have more than doubled their output since 1919. The Austrian banks have taken a very active part in developing the power which its mountain lakes and rivers have bestowed on the republic. Further particulars of Austria's water power are given in the *Electrical Times* for Sept. 20.

MR. MATTHEW W. STIRLING has been appointed chief of the Bureau of American Ethnology, Smithsonian Institution, Washington, D.C., in succession to Dr. J. Walter Fewkes, who retired early this year.

ON the retirement of Major Leonard Darwin from the office of president of the Eugenics Society, the fellows and members are presenting him with a portrait. The presentation will take place in the rooms of the Linnean Society, Burlington House, W.1, on Wednesday, Oct. 10, at 5.30 P.M.

THE autumn meeting of the South-Eastern Union of Scientific Societies will be held on Saturday, Oct. 27, when visits will be paid to the Croydon Aerodrome and Air-Port and to Whitgift's Hospital, Croydon. Particulars can be obtained from Mr. E. A. Martin, "Croham Hyrst," St. Lawrence, Isle of Wight, or Mr. R. W. Strickland, 5 and 6 Clement's Inn, W.C.2.

AN unusually extensive edition of the old-fashioned travelling menagerie is being put on the road by Chapman's, the well-known animal dealers of Tottenham Court Road, London, W.C.1. Its extent is indicated by its major attractions, which include 14 lions, 12 tigers, 10 zebras, 10 polar bears, 8 other bears, 7 leopards, and 200 'various species,' which we imagine means *specimens*, of monkeys, as well as many lesser mammals and interesting birds. Beginning on Sept. 24 at Chelmsford, the route traverses the midlands of England, and ends with a month's exhibition in Glasgow in December and January. The passing of this large collection should afford an opportunity for many who are out of touch with the larger zoological gardens to see a good selection of the interesting creatures of other lands.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A resident chaplain and lecturer in mathematics ; or a resident lecturer in mathematics and physics at the York C. of E. Training College for Schoolmasters—The Principal, St. John's College, York (Oct. 14). A research assistant, under the Safety in Mines Research Board, for work in connexion with wire ropes used in coal mines—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (Oct. 15). A head of the Engineering Department and assistant headmaster of the Junior Technical School of the Darlington Technical College — The Chief Education Officer, Education Office, Darlington (Oct. 18). A senior chemistry master at the Hull Grammar School—The Headmaster, Grammar School, Hull (Oct. 20). A principal of the Denbighshire Technical Institute—The Secretary and Director of Education, Education Offices, Ruthin (Oct. 29). A professor of pathology in the University of Otago, Dunedin —The High Commissioner for New Zealand, 415 Strand, W.C.2 (Oct. 31). A lecturer in metallurgy at the Birmingham Central Technical College—The Principal, Central Technical College, Suffolk Street, Birmingham (Nov. 3). An analyst at the Harper Adams Agricultural College—The Principal, Harper Adams Agricultural College, Newport, Salop. A senior mathematical mistress at the Cheltenham Ladies' College—The Principal, Ladies' College, Cheltenham. A senior mathematical mistress at the Bath Royal School—The Principal, Royal School, Bath. A master for chemistry, physics, and mathematics at Connell's Institute, Belfast—The Principal, Connell's Institute, Belfast. Teachers of third year machine design and third year engineering calculations, under the Croydon Education Committee—The Principal, Central Polytechnic, Scarbrook Road, Croydon.

Our Astronomical Column.

THE PLANET MERCURY.—*Revue Scientifique* of Aug. 11 contains an illustrated article on this subject by M. L. Rudaux, who has been observing the planet at intervals since 1893 at his observatory at Douville. His aperture of 4 inches is rather small for this purpose, but he enjoys a good atmosphere, and several of the sketches reproduced show a considerable amount of detail. His chart of the planet resembles in many of its features that published a year ago by M. E. M. Antoniadi from his studies with the great Meudon refractor. Both charts show the dusky regions much broader than the narrow streaks in Schiaparelli's chart ; for some markings all three charts agree, so these can be accepted with much confidence.

Schiaparelli and Antoniadi both considered that the planet's equator coincides with its orbit plane, but Rudaux suggests that there is an angle of 10° between them, the summer solstice of the northern hemisphere occurring a little after perihelion. He agrees with the other two in making the rotation coincide with the revolution (88 days), so that a large region has perpetual day, and another large region perpetual night. Owing to the very unequal motion in the orbit, arising from the large eccentricity, the region of perpetual night extends over only 133° of longitude instead of 180° for a circular orbit.

A BIG SUNSPOT.—During the latter part of September it was possible for a few days to see at the same time two spots on the sun's disc as naked-eye objects. The first spot to be seen crossed the central meridian on Sept. 24. On the same day a moderate magnetic disturbance, commencing with a typical 'sudden commencement' at 16½ h., was recorded at Greenwich. This disturbance, which lasted until about 2 h. on Sept. 26, had a range in declination just exceeding ½°.

The second spot, or rather group of spots, was a remarkable one. When first observed near the east limb, it appeared as a 'bipolar' group or stream developing in the usual manner, but within four days it had grown rapidly and had become an immense complex group. Approximate measures of its area, corrected for foreshortening, in millionths of the sun's hemisphere, are given at intervals of 48 hours—

Sept. 22.	Sept. 24.	Sept. 26.	Sept. 28.
600	1400	2500	2500

Changes in structure were especially noticeable between Sept. 24 and 25. Judged from its maximum area, this is the largest group which has appeared since the great spot of January 1926.

No further magnetic disturbance of any note had occurred, however, up to 10 h. on Oct. 1.

Other particulars of the two spots are given as follows, the areas being expressed as the proportion of the hemisphere covered.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Maximum Area.
8	Sept. 18–Sept. 30	Sept. 24·4	15° N.*	1/750
9	Sept. 21–Oct. 3	Sept. 27·4	15° S.	1/400

* A large spot in the same latitude and longitude crossed the central meridian on July 31 (see NATURE, Sept. 22, p. 453).

Research Items.

THE MORIORI OF CHATHAM ISLAND.—Vol. 9, No. 5 of the *Memoirs of the Bernice P. Bishop Museum*, is a further study of the Moriori, which is the result of a second visit paid to Chatham Island by Mr. H. D. Skinner in 1924, supplemented by an account of their life and customs by Mr. William Baucke. This supplements and extends the conclusions at which Mr. Skinner arrived in his previous memoir, as well as corrects other accounts which he considers vitiated by faulty evidence. He is of the opinion that there were two influxes of the Moriori into the Chatham Islands, of which the southern, the Rauru, was pre-eminent, but holds that the Moriori claim that they were autochthonous is incredible. The theory that the islanders were immigrants from New Zealand is fallible, unless it can be shown that the two types co-existed in New Zealand or that two immigrations into New Zealand were repeated in the same successive and separate manner in the Chatham Islands. It is possible that the northern and weaker strain was the first to arrive and began to decay on the arrival of the second; but there is no evidence to show whether the northern Wheteina or the southern Rauru was the first. Nothing is known of inter-tribal wars which can be construed as history, while there is no evidence for the construction of the fortified villages on the lines of the Maori *pa*, which have been attributed to them, the suggestion that there were being due to knowledge of such structures obtained from Maori stories. Notwithstanding their genealogies, the evidence of the deeply rutted native paths in hard cemented quartzite points to a stay in the islands of not less than a thousand years.

EYE PROTECTION.—Owing to the recent legislation in the United States on the protection of the eyes of workers from injurious radiations, the Bureau of Standards has investigated the best methods of testing the opacities of the glasses used for that purpose, and their results are given in *Technologic Paper*, No. 369. In the case of ultra-violet radiation, the best source is the quartz mercury arc, but the carbon arc with nickel or aluminium cored carbons, or the gas-filled tungsten incandescent lamp may be used. The transmission is measured by the spectroradiometer. For visible radiation a 500-watt 110-volt gas-filled tungsten lamp is used and the transmission measured by photometer. For the infra-red the tungsten lamp is again used, but the transmission is measured by a thermopile with a red glass covering it. The thickness of the glass plates tested is about 0·2 cm. Tables are given of the properties of more than eighty glasses manufactured by eleven American glass makers, and nine other substances, including fused quartz.

TREMATODES OF BIRDS.—The attention of workers on the trematodes of gulls, scoters, and other marine birds is directed to a paper by Edwin Linton (*Proc. U.S. Nat. Mus.*, vol. 73, art. 1, 1928), in which trematodes taken from birds at Woods Hole, Mass., are described and figured. These include new species of *Hœmatotrephus, Psilostomum, Petasiger, Himasthla, Aporchis, Ascocotyle, and Minuthorchis* (n. gen.).

THREE SPECIES OF BIRD MALARIA.—E. Hartman (*Arch. f. Protistenkunde*, **60**; 1927) points out that the nomenclature of the parasites of bird malaria is very confused. He proposes to restrict the name *Plasmodium prœcox* to a parasite in birds having crescent-shaped gametocytes and not markedly different in its morphology from *P. falciparum* of man. He describes two new species of *Plasmodium* which have spherical gametocytes; in *P. cathemerium* these contain rod-shaped pigment granules and in *P. inconstans* nearly spherical pigment granules. All three species were found in Nature in the English sparrow in the United States and have been grown experimentally in the canary.

INEFFECTIVENESS OF INTERNAL MEDICATION OF POULTRY FOR CONTROL OF EXTERNAL PARASITES.—In view of a general impression among farmers and poultry-men that certain substances administered internally will protect animals from external parasites, the United States Department of Agriculture has carried out investigations on the subject (*Tech. Bull.*, No. 60; 1928). The prevailing idea is that the substance administered is taken up by the blood and excreted on the surface of the body or on the body-coverings, and when the external parasites come in contact with the material they are thereby poisoned or repelled. Hens were used in the experiments, and the substances tested included magnesium sulphate, naphthaline, calcium thiosulphate, sulphite, sulphate and sulphide, sodium carbonate and sulphate, potassium iodide, tartar emetic, sulphur, camphor, powdered tobacco, and quinine sulphate. The tests show conclusively that the external parasites of the hen are not adequately controlled by internal administration of these substances. Such treatment not only involves useless expenditure but also allows the parasites to continue their ravages when they might be destroyed by recognised methods.

THE LONG-TAILED SHREWS OF NORTH AMERICA.—In 1828, when Sir John Richardson described the mammals of the preceding Franklin expedition, only three species of shrews were known from the American continent, and now Hartley H. J. Jackson has examined 10,431 specimens belonging to the genera *Sorex* and *Microsorex*, and finds that they constitute 89 forms belonging to 39 species, all of which he describes in detail (*U.S. Dept. Agr., Bureau of Biol. Surv., North American Fauna, No. 51,* July 1928). Shrews are in many respects primitive mammals; their fur shows no sharp distinction into underfur and overhair, they exhibit little individual variation, no sexual variation, and little variation with age. Seasonal variation, associated with the spring and autumn moults, is limited to the length and tint of the pelage, and geographical variation is shown in variations of paleness and darkness, in size, in tail length, and in the general shape of the skull, particularly in the contour of the brain-case and the length of the molar tooth row. Individual sub-species generally have an extensive geographical range. Of their habits, perhaps the most remarkable are their savage voraciousness (one individual has been known to devour its two companions in the course of eight hours), their normal gluttony (they have been known to eat their own weight in meat every three hours), and the aquatic perfection of the water-shrews, some of which are said to swim with relatively greater speed and skill than the otter, and must be ranked amongst the best swimmers of non-marine mammals.

THE TREATMENT OF FISH DISEASES.—During the year 1927 fifty-seven institutions and individuals in various parts of the world were circularised in an effort to gather data from those who had studied the diseases of fishes. In *Zoopathologica*, vol. 2, No. 1, April 30, 1928, Ida Mellen gives tables which describe the symptoms of a large number of ailments suffered by aquarium fishes and show the treatment recommended by various investigators. These tables can scarcely be dealt with in a short note, but they merit the attention of those either responsible for or interested in the health of fishes in public or private aquaria.

DEVELOPMENT *IN VITRO* OF THE OTIC VESICLE OF THE CHICK.—Dr. Honor B. Fell (*Arch. f. Zellforsch.*, 7, 1928) has investigated the development *in vitro* of the isolated otocyst of the embryonic fowl. The otic vesicle was dissected from one side of a three-day chick, and placed in a tube on the surface of a clot of plasma and embryo extract, and maintained at 38° C. The otic vesicle of the other side, with its adjacent tissue, was fixed and sectioned. The explanted vesicle was washed every 48 hours in a drop of embryo extract and transferred to a tube with fresh culture medium. Such vesicles gave rise to all the epithelial constituents of the fully formed auditory labyrinth. Regions of tissue identical in histological structure with the normal ductus and saccus endolymphaticus, sensory areas (including Corti's organ) and the tegmentum vasculosum were formed. The principal epithelial structures developed in these cases in approximately the same relative positions as the corresponding structures in the normal embryonic labyrinths ; as compared with the latter, the rate of tissue differentiation in the explanted otocysts was almost normal, but the growth rate was greatly diminished, and there were only slight indications of anatomical differentiation, the tendency being towards the retention of the primitive vesicular form. The author concludes that the normal histological differentiation of the otocyst of the three-day embryonic fowl does not depend upon a vascular system, nervous connexions, association with adjacent organ rudiments, a correlative anatomical differentiation, or a normal rate of growth.

THE ROOT AS AN ABSORBING ORGAN.—In two recent papers, Scott and Priestley re-examine the question of water absorption by roots, and make suggestions tending towards a more simplified view of the whole problem of root absorption (*New Phytologist*, vol. 27, No. 3). The absorbing region of the root is the area lying between the apical meristem and the region with completely suberised membranes. Now the protoplasts of the endodermis are attached to the radial walls of the cells, and thus form a continuous protoplasm membrane round the central cylinder. The authors consider that when water is present in excess the soil solution permeates the cellulose walls of the cortex, and water can be drawn across the endodermis by the osmotic pull of the solution inside the central cylinder. Thus the absorbing surface of the root is considered to be a definite area of endodermis, and the surface area of the root not important. In drier soils, water is less free to move in the soil, and importance attaches to the increase in root surface due to growth and the production of root hairs, since the rate of entry of water from the soil into the root surface necessary to maintain an adequate supply across the endodermis diminishes in direct proportion to the ratio of root surface to endodermal surface. Therefore, in comparatively dry soils, root hairs perform an important function in relation to the entry of water. Experiments with lead salts and dyes showed that the suberised cells of the exodermis are not permeable to these substances, but the unsuberised cells act as passage cells. They may become blocked in older regions. The distance behind the meristem at which suberisation of membranes appears, varies with the season. Examples from diverse groups of plants show that the typical absorbing zone may be eliminated by the development of suberised exodermis and endodermis to within a short distance of the root apex, and the completion of the closure by fatty impregnation of the walls of the superficial cells.

WIND AND TIDE IN THE IRISH SEA.—In an article on this subject in the *Marine Observer* for October, Mr. M. Cresswell gives some account of observations at the ports of Holyhead, Fleetwood, Preston, and Belfast. These observations show that wind force associated with a rapid change of pressure, that is a sudden gale, alters the sea-level more quickly and to a greater extent than a more gradual change of pressure and wind. On one occasion an excess height of 10 feet occurred in the tide during the passage of a heavy westerly gale. This was the cause of the disastrous floods at Fleetwood and Preston about the end of October last year. The outstanding feature of the year in the area under consideration was the correlation of a mean pressure below the normal with tidal heights departing from the predicted levels. Detailed observations are not given in the paper except in regard to the October gale.

RAINFALL OF AUSTRALIA.—The rain map of Australia for the year 1927 gives maps of the monthly and annual rainfall and maps showing the departure from the average fall. The year showed an improvement on the last five years, inasmuch as 34 per cent of the country had a rainfall exceeding the normal. In previous years the average was 25 per cent of the country. Not since 1921 has 50 per cent or more of the country had an excess. The excess was, however, localised and experienced mainly in the more arid regions of Western Australia and in eastern Queensland. In the greater part of the central plains in Queensland, South Australia, and New South Wales, severe drought conditions again occurred. The agricultural season (April to November) was characterised by several critical periods of rain shortage, but in October the fall improved and the resultant harvest, though below normal in the eastern States, was better than had been anticipated. In Western Australia the wheat and pastoral lands had one of the best of recent years. The maps are based on the records of 1300 stations, and the only area without data is the interior of Western Australia and the adjoining parts of South Australia and the Northern Territory.

THE GILBERT MAP OF 1582–83.—In the sale of the library of Lord Leconfield in the spring of this year, there came to light among a number of documents relating to the early history and geography of America a hitherto undescribed manuscript map of North America and the Arctic regions inscribed with the name of 'Humfray Gylbert.' A reproduction of this map, with an article on its significance by Mr. B. P. Bishop, appears in the *Geographical Journal* for September. The map appears to have been drawn, at latest, in 1583, the year in which Gilbert sailed on his last voyage to Newfoundland. It bears the symbol of Dr. John Dee, who is known to have been interested in projects for colonisation and so may be regarded as partly his work. The chief interest in the map lies in the light it throws on Gilbert's project of the discovery of a sea-route to China by the north-west, and helps to explain his motives in his voyage to Newfoundland in 1583. A strait is depicted as joining the St. Lawrence with the Gulf of California, and so forming a route by which an English colony might be carried to the Pacific coast of America without encroaching on the Spanish sphere of influence. Mercator in 1569, and Ortelius in 1570, had shown the St. Lawrence as a river without any opening to the west, and Gilbert's emendation of the map was apparently done to enhance the chance of his proposals finding acceptance.

Cardita beaumonti Beds in Baluchistan.—The description of the fauna of the *Cardita beaumonti* beds of India was originally entrusted by the Geological Survey of India to the late Maurice Cossmann, who, however, found himself obliged before his death to delegate the task to Prof. H. Douvillé. The latter has already dealt elsewhere with the fauna of their western extension into Persia, and here devotes his first part, which is in French, to an account of the fossils of the Baluchistan representatives of the formation (*Pal. Ind.*, New Series, vol. 10, No. 3). The beds there are characterised by the abundance of Cerithiidæ and Melaniidæ, among them being a representative of the rare genus, *Pseudoglaucoma*, first described by the author from the Eocene of Peru. The fauna indicates sublittoral or lagoon conditions, and if certain species have their analogues in Parisian Tertiary, they point also to the existence of a warmer environment. Thirty-four species are dealt with, of which just one-half are considered to be new, while five are indeterminate. There are four photo-type plates, which are as good as the process permits of.

Pacific Ocean Land Snails.—Under the comprehensive title of "Land Snails from Hawaii, Christmas Island, and Samoa," by H. A. Pilsbry, C. M. Cooke, jr., and Marie C. Neal, a collection of five papers has been issued by the Bernice P. Bishop Museum (*Bull.* 47). In the first on "*Georissa*, a . . . genus new to the Hawaiian Islands," Dr. Pilsbry describes three new species. Investigation of the "Food habits of *Partula zebrina*, Gould," by C. M. Cooke, founded on specimens taken in American Samoa, goes to show that this herbivorous mollusc has acquired the habit of swallowing other species of snails whole—it is presumed solely with the object of procuring lime. The same author seeks to identify and define "Three Endodonta from Oahu," entering fully into their shell characters and anatomy. Mr. Cooke and Marie C. Neal deal with the "Distribution and anatomy of *Pupoidopsis hawaiiensis*." All the Hawaiian specimens are fossil, but living examples were found on Christmas Island more than 1200 miles distant. The authors conclude that both in shell characters and anatomy *Pupoidopsis* is closely related to *Pupoides*. In her "Anatomical Studies of Achatinellidæ," Marie C. Neal seeks to answer the question : Do the genera and species of Achatinellidæ differ anatomically ? The results of her careful investigations go to show that divisions of the family by shell characters and by anatomical characters do not agree, but that the section *Perdicella* should have generic rank, whilst the similar claim already made for *Newcombia* is confirmed. The series of papers, which are illustrated by text figures, is a worthy addition to the contributions of the Museum.

The Dielectric Constants of Ammonia, Phosphine, and Arsine.—The *Journal of the Indian Institute of Science* (vol. 11A, Part V.) contains an account of an investigation by H. E. Watson of the variation of the dielectric constants of ammonia, phosphine, and arsine with temperature and pressure. It was not possible to extend the work to stibine, as its ready decomposition with the formation of a metallic mirror would result in the breakdown of the insulation of the gas condenser. The measurements were made at high frequency, two coupled oscillating systems being employed, and an accuracy of 1 per cent was aimed at for the final results. It was found that ammonia and phosphine approximately satisfy Debye's equation for the change in dielectric constant with temperature, while arsine appears to behave similarly to the permanent gases in this respect. The variation of dielectric constant with pressure indicated that it is justifiable to assume that $\epsilon - 1$, where ϵ is the dielectric constant, is proportional to the density. The value of the electric moment is greatest for ammonia and smallest for arsine.

A Frequency Standard.—It is interesting to notice that engineering physicists are beginning to question whether the accuracy of the rate of the earth's rotation round its axis is sufficient for their measurements. If the length of the day alters by about one second in ten years, this would soon cause an appreciable discrepancy between reference standards. Hence they are beginning to consider whether something more fundamental than the rate of the earth's rotation should be adopted as a standard. In the *Bell Laboratories Record* for August, W. A. Marrison points out that in electrical communication we have to work with frequencies ranging from less than unity per second to a hundred million or more per second. It seems now possible to maintain frequencies constant to one part in ten million, for several seconds. In fact, in successful television this is done. The new form of reference standard which has been developed is an oscillator controlled by a quartz crystal. The equipment used by the Bell Company for determining the frequency of the crystal is somewhat similar to that used with a tuning-fork standard. A clock is driven by a synchronous motor controlled by a current the frequency of which is an exact submultiple of the frequency of the crystal. When the high frequency has its normal value the clock keeps accurate time ; any variation in the rate of the clock is a measure of the error of the standard. So constant is the frequency of the crystal that the clock controlled by it keeps time with a maximum inaccuracy of less than one-tenth of a second per day. In the crystal oscillator standard at present in use, the frequency is 50,000, and the derived frequency of the current which actuates the clock is 1000. The temperature coefficient of the crystal is much smaller than that of a steel tuning-fork, but it is necessary to control the temperature to within about the one-hundredth of a degree centigrade. The accuracy of the beat frequency measurement when interpreted as the accuracy of the oscillator is increased many times.

New Low-power Binocular Microscope.—Messrs. R. and J. Beck, Ltd. (69 Mortimer Street, W.1), have introduced a new form of low-power binocular microscope, the 'Beck Binomax.' It consists of two complete microscope systems, each with a prismatic erecting arrangement, inclined to each other at the natural convergence of the eyes, the interocular distance being adjustable. The object glasses are held in tubular mounts with the lenses at one end. Each object glass is so threaded that it may be inserted in the tube either way, so that the tubular mount projects out of, or inside, the body tube. The distance between eye-piece and object glass is thus variable, and two different powers are obtainable, without interfering with the optical performance. Two pairs of eye-pieces of different powers are provided, and four powers in all are therefore available, with magnifications of 4, 8, 16, and 32 respectively. Various stands for the 'Binomax' are obtainable, and the body may be used interchangeably on any form of Beck stand listed. The working distance is considerable—110 mm. for the two lower powers, and 75 mm. for the two higher ones. We have inspected the instrument and its performance is excellent ; it should be of great service for the examination of large opaque objects, such as rock specimens, for dissections, and other purposes.

Wordsworth as a Pioneer in the Science of Scenery.[1]

By Dr. VAUGHAN CORNISH.

THE pre-eminence of Wordsworth as a poet of Nature has long been recognised, but there is another aspect of his originality which has not yet received adequate recognition. Wordsworth wrote "A Guide through the District of the Lakes in the North of England with a Description of the Scenery," which appeared in several editions between 1810 and 1835. The "Guide" proper is brief, the author regarding this portion of his task as "humble and tedious," and he soon plunges into his description of the scenery. Here at once we find scientific originality, for he not only records physical appearances, but also, whenever they give keen enjoyment, seeks the source of the impression, investigating both the objective conditions and the mental qualities concerned in their appreciation. Moreover, he writes in the hope that his essay may lead to habits of "more considerate observation than have been hitherto applied to local scenery."

Consideration saved Wordsworth from the sentimental assumption that the aspect of Nature is always harmonious. He points out, for example, a 'defect' in the colouring of the Country of the Lakes. But his faculty of observation made him quick to recognise the conditions in which objects in the view enhance one another, the harmonies which are the true beauties of scenery. Thus he directs attention to the circumstance that the radial arrangement of the English Lakes from a mountainous centre introduces every variety of the sun's shadowing. He points out that the mountains of the district differ from hills not merely in mass but quality, owing to the atmospheric absorption which etherialises the summit when viewed from the valley. He notes the height which must be attained that "compact fleecy clouds" should settle upon the crest. Among "the varied solemnities of the night" he recognises the singular charm of stars which "take their stations above the hill tops"—an excellent observation of enhancement due to a momentary and accidental relation. He feels the romantic, almost poignant interest of the line of the trees which maintain themselves against the elements at the limit of altitude. The charm of intermingling of field and woodland in the Lake Country he traces skilfully to the progressive agricultural settlement which followed "the veins of richer, dryer, or less stony soil." With equal acuteness he indicates how the peculiar economic character of the district has resulted in innumerable lanes and paths which provide the rambler with "an ever ready guide" to "the hidden treasure of its landscapes."

Although preferring the harmonies of occupation and environment displayed in a highland community of small owners before all other aspects of the scenery of civilisation, Wordsworth pays discriminating tribute to the unique contribution made by wealthy inheritors of landed estate in the preservation of trees beyond economic prime for sheer love of their beauty in venerable age. He notes the geological conditions to which the water of the English Lakes owes the remarkable clearness that makes their depths a magic mirror to lead the mind into "recesses of feeling otherwise impenetrable." He does not, however, discover the peculiarities of the watery image which are the source of this mental effect. We must remember that Wordsworth was making a beginning only in the science of scenery, and that with the advantage of another hundred years of accumulated knowledge we can better his instruction. But even so it is remarkable that we should now be taking up the æsthetics of scenery very nearly from the point where he left it, joining hands across a hundred years, rather than proceeding from the mainly orographical studies of scenery produced in the latter part of the nineteenth century.

The "Guide" proper and the "Description" are followed by the third section of the book, which is on "Changes, and rules of taste for preventing their bad effects." Wordsworth dates a more general appreciation of the wilder aspects of scenery from about the year 1775. Thereafter the country of the English Lakes not only attracted visitors, but also, owing to its economic conditions, offered more opportunities for settlement by villa residents than districts parcelled out in great estates. The epoch of railway construction followed, with the result that the changes in the English Lake District in Wordsworth's middle and later life were comparable to those which, owing to the development of motor traffic and the extension of house building, now affect rural England as a whole. Wordsworth points out to the newly-arrived resident that the liking for "strong lines of demarcation" and emphatic contrast is due to want of practice, and that if he will pause to study his rural surroundings "a new habit of pleasure will be formed the opposite of this, arising out of the perception of the fine gradations by which in Nature one thing passes away into another." The rule that a house situated in mountain scenery should be so designed as to take its place quietly in the landscape is enforced by the penetrating remark that owing to the scale of the view "a mansion can never become principal in the landscape" as it may "where mountains subside into hills of moderate elevation."

This example of Wordsworth's *flair* for noting the relation of the object of attention to its environment is curiously paralleled by his observation of the effect of the echo of the cuckoo's call from the steep sides of the Rydal Valley. The sound, he says "takes possession" of the valley, an expression which is implicit with suggestion of the important fact that the view is made impressive by any agent which imparts unity to objects the multiplicity of which often prevents the landscape from appearing to the mind as a picture. Here I pause to remark that the sounds and scents of the countryside belong to its scenery. If we did not make the letter *c* soft in the word scenery we should be less apt to forget that the word has no derivational connexion with 'seeing.' The visual is no doubt the leading aspect of scenery, but æsthetically we are bound to take account of the simultaneous impression of the natural environment, or scene, upon the other senses. It follows that the societies which concern themselves with the preservation of scenic beauty are within their province in combating unnecessary mechanical noise.

When changes come, Wordsworth is not always apt in recognising a new harmony. His failure to observe the rhythmic reinforcement of rocky pinnacles by trees of pointed form diminishes the efficacy of his protest against the introduction of the larch. His preference for informal lines may have been partly innate but was increased out of measure by intellectual associations, which do so much to cramp the proper functioning of the eye. Thus in the letter to Sir George Beaumont, dealing with the laying-out of grounds, written so early as 1805, which is included as

[1] Paper read at the Conference of Delegates of Corresponding Societies of the British Association, session of Sept. 11, dealing with the scenery of the English Lake District and its preservation.

an appendix in Mr. de Selincourt's recent collation of the editions of the "Guide," Wordsworth assumes that every person of taste would prefer that the whole garden should be as near to Nature as possible, and pays no regard to the circumstance that in the immediate vicinity of the mansion it is permissible to prefer formal lines on account of their harmony with those of architecture. Thus, although Wordsworth may have been in advance of his time as an advocate of the free play of the senses, he did not go so far as we now know to be desirable.

Mr. de Selincourt has included as a second appendix letters to the *Morning Post* written by Wordsworth in 1844 on the subject of the proposed Kendal and Windermere Railway. Descending to the dusty arena of practical affairs, his academic mind loses something of its lofty detachment. It is interesting to compare these letters with a recent work entitled "England and the Octopus," dealing with the things that to-day impair the peacefulness of our scenery. The style of Wordsworth is indeed less trenchant than that of Mr. Clough Williams-Ellis, but underlying exasperation is almost equally evident. On the whole, however, it is when Wordsworth is dealing with general principles that he is of most service to the cause which so many of us have at heart, the preservation of scenic beauty, and we may well take the concluding paragraph of his "Description" as the text of our present appeal for preservation of scenic amenity in the countryside generally and the district of the English Lakes in particular:

"It is then much to be wished that a better taste should prevail among these new proprietors; and, as they cannot be expected to leave things to themselves, that skill and knowledge should prevent unnecessary deviations from that path of simplicity and beauty along which, without design and unconsciously, their humble predecessors have moved. In this wish the author will be joined by persons of pure taste throughout the whole island, who, by their visits (often repeated) to the Lakes in the North of England, testify that they deem the district a sort of national property, in which every man has a right and interest who has an eye to perceive and a heart to enjoy."

Jubilee Congress of the Folk-lore Society.

THE Jubilee Congress of the Folk-lore Society was held, as previously announced, on Sept. 19–25 in London, the president being the veteran scholar, Lieut.-Col. Sir Richard C. Temple. With the exception of one session on the evening of Sept. 20, which was held at the Imperial Institute, the meetings were held in the rooms of the Society of Antiquaries, which had been placed at the disposal of the congress by the Council of that body.

The congress, though small in numbers, was distinguished in its membership, and a number of prominent folk-lorists from abroad were present, mostly representing continental or American bodies. Among them were Dr. Fritz Boehm, of Berlin, representing the Vereins für Volkerkunde; Dr. Gudmund Schütte, of Sweden; Miss A. W. Beckwith, representing the Folk-lore Foundation of Vassar College, N.Y.; Dr. Marcu Beza, of the Rumanian Academy; Prof. Y. M. Goblet, of the Société Ernest Renan, Paris; Prof. R. Pettazoni, of the Universities of Rome and Bologna; and Dr. Rütimeyer, of the Schweitzer Gesellschaft für Volkerkunde. A number of British societies were also officially represented.

It may not be inopportune to recall that when the Folk-lore Society was founded in 1878 by a small band of enthusiasts, among whom the late William J. Thoms and the late Mr. (afterwards Sir) Laurence Gomme were the leading spirits, the subject of its study had hardly won a generally recognised name. There would also seem to have been no very precise agreement as to its exact object and scope. So much so that, even in a leaflet published on behalf of the Society some years later, it was felt necessary to explain in what respects the science of folk-lore differed and was distinguishable from other studies with which it was in danger of being confused. The reason for this, of course, was that the Society had not confined itself to the study of survivals among civilised populations and the collection of folk-tales, but had included the study of certain aspects of 'savage' culture within its scope, and might, therefore, have been thought to be encroaching too broadly upon the province of ethnography.

On many occasions Sir Laurence Gomme in his writings, and notably before the Anthropological Section of the British Association, endeavoured to lay down the line of demarcation of his studies. Although the lines may have been overstepped, in general and as a matter of practice the Society's field of operations has been well marked out. Its original aim was two-fold: the collection of the customs, beliefs, sayings, etc., of the folk, and secondly, the classification, comparison, and interpretation of the matter thus collected. A valuable handbook for collectors was prepared which has been revised as the development of the study has required, and the work of the Society has been recorded in a journal which has been supplemented by the publication of supplementary volumes, either original studies too lengthy for inclusion in the journal or reprints of 'classics' of folk-lore almost unobtainable in their original or indeed in any form.

It is worth while to recall these facts in connexion with this congress, for it cannot but be felt that the Society and the study it represents are not receiving in this jubilee year the support from the public which they deserve. The study of folk-lore was taken up with some vigour on the Continent, where the term, first used by W. J. Thoms and adopted in England to distinguish the subject, was accepted as the official designation of the study of the culture of the people.

The recognition that is now accorded such studies on the Continent is indicated by a communication presented to the congress by Dr. Fritz Boehm, in which he surveyed the academic position of folklore in Germany. In Prussia folk-lore, since the educational reform of 1925, is being introduced into the curricula of the elementary school, the secondary school, and the university, and other States will probably follow this example. In fact, it is represented in some form or other in most German universities. Yet Dr. Boehm lamented the fact that Germany is behind Scandinavia in this respect, as was in part borne out by Dr. A. Cyriax's account of the study of folk-lore and art in Sweden and the museums devoted to it. While this is not the occasion to enlarge upon such reflections as this contrast with conditions in Great Britain may suggest, it is perhaps worth while to point out that, though the important work of collection must not be neglected now that the material is disappearing more rapidly than ever in the stress of modern life, too little attention may be given to the work of analysis, synthesis, and comparison which gives meaning to the isolated facts and keeps alive the interest of an intelligent but uninstructed public.

Turning to the proceedings of the congress, it is gratifying to observe that so far as the number and quality of the papers was concerned the congress was a success. The meetings were well attended and the papers followed with close attention, even in those few cases in which the authors were not able to attend in person.

The president, Sir Richard Temple, a contributor to the proceedings of the Society almost from its inception, in his address on "The Mystery of Mental Atmosphere," dealt with a topic of no little philosophic import. He sought the origin of magic in the attempt of the primitive mind to bridge the gap that philosopher and savage alike reach at the point which is beyond experience and passes understanding. Recalling an observation of his own on a voyage to Rangoon, which revealed to him that a personage, al-Khidr, had been identified among the people with almost every hero of the past and many smaller local ones, he argued that such beings as this represent to the populace the unknown and mysterious by which they endeavour to bridge the gap, while the mind, clinging, as Andrew Lang suggested, to whatever it absorbs, modifies it, and by each contact produces an atmosphere which overlaps but never destroys those produced by previous contacts. Folklore, therefore, to be scientific in studying any given belief, should ascertain the mental atmosphere at the time of absorption of the people who had absorbed it.

The proceedings of the congress covered a wide range, both geographically and in subject matter. One of the most striking papers in its choice of subject was a study of stone-carrying women, by Mrs. Banks, who has followed up the persistent story in western Europe of women who dropped stones from creels on their shoulders or from their aprons, among whom even the Virgin Mary found a place. She sought to connect the legend with the clearing of land by women as early agriculturists.

Several contributors offered papers on extra-European folk-lore. Prof. Sayce, who was one of the original members of Council of the Society, dealt with Egyptian folk-lore, as did Miss Blackman in its medical aspect; Mrs. Spoer (Miss Goodrich-Freer) with Hebrew amulets; Capt. M. W. Hilton-Simpson with medical magic in Algeria. Prof. Starr sent a communication on Filipino magic, and Mr. R. E. Enthoven described beliefs connected with tree and animal worship in India, and showed the identity in the conception of tree, animal, and human soul.

Among papers dealing with the Near East were Prof. R. M. Dawkins on the study of folk-lore in modern Greece, and an interesting account of mummers' plays in Attica by Prof. H. J. Rose. Mrs. Hasluck described "the most primitive people in Europe outside Russia"—the Sarakachan people, who spend the summer in the Pindus mountains and the winter in the plains of Macedonia. She has visited two branches of these people, one the Albanian Vlacks, and the Sarakachan peoples proper, who, curiously enough, owing to local conditions, have reverted from a settled to a nomadic life. Dr. Beza gave the congress a view of Rumanian folk-lore in his account of the work of Demetrius Contemir's contribution to folk-lore, and Prof. Gudmund Schütte dealt ably with the evidence for the worship of the bull among the Kimbri. In the evening session at the Imperial Institute, Prof. Pospisil, of Brno, gave an account illustrated by a kinematograph film of the folk dances and customs of Central Europe.

British folk-lore was well represented, and offered one of the most interesting of the papers presented at the congress in an account of witchcraft in Wales, of which perhaps the most striking feature was the extent to which the belief is still prevalent among the educated. A witch has been considered a more efficacious thief-finder than a policeman, and a piece of moleskin worn on the chest of more avail than a doctor. The use of written charms in English suggests an English origin for some forms of the belief. Mr. T. W. Thompson's interesting account of British gypsy marriage and divorce customs included references to the eating of the blood-cake and the jumping of the bride and bridegroom over a branch of flowering broom or a besom made of broom. A paper was presented on behalf of Canon MacCulloch discussing aspects of the Arthurian legend, and Miss Mona Douglas gave an account of various beliefs relating to animals in Manx folk-lore, according to which cows were held most susceptible to witchcraft, and the witch was believed to take the form of a hare. Miss B. C. Spooner described 'charming' in Cornwall, the counterpart of the modern faith-healing. A suggestive paper by Prof. Pettazzoni on confession among primitive people, described the confessional as an analogue of the expulsion of sin or disease by washing or drawing of blood, the evil being expelled by verbal enunciation.

A fitting climax to the prominence of witchcraft in the proceedings of the congress was a communication from M. P. Saintyves, which was read by M. Goblet, on the 'witches' sabbath,' in which the author maintained the existence of a magic religion and secret church of wizards in the Middle Ages.

The programme on the concluding day included papers on the psycho-analytic side of folk-lore. Dr. Ernest Jones, in dealing with the question generally, made special reference to the significance of beliefs relating to the number three. Dr. Roheim dealt with "Mother Earth and the Children of the Sun."

The social side of the congress was not neglected. It opened with a presentation of the delegates to the president by Prof. J. L. Myres, and the members were entertained by Dr. Henry Wellcome at the Historical Medical Museum, and by Mr. and Miss Canziani. Visits were paid to Oxford and Cambridge; the English Folk Dance Society gave a demonstration of folk-dances, folk-songs, and children's singing games; and an official dinner was held on the concluding day.

Energy and Atoms.

A MESSEL memorial address, entitled "Available Energy," was delivered by Prof. R. A. Millikan on Sept. 5 in New York at a joint meeting of representatives of the British Society of Chemical Industry and the Institution of Chemical Engineers with the American Institute of Chemical Engineers. As might be expected from Prof. Millikan's recent researches, his treatment of his subject proceeded upon somewhat unorthodox lines, and in the greater part of his lecture he was concerned with astronomical problems, rather than with the physical and engineering thermodynamics suggested by his title. The apology he made for offering an apparently abstract subject of this nature to a technical audience was the fact, perhaps usually insufficiently appreciated, that many of the distinctive features of modern civilisation come from our present knowledge of mechanics, which, in turn, was largely developed through the pioneer work done in the seventeenth and eighteenth centuries upon extra-terrestrial problems.

The fundamental work of Prof. Millikan and Dr. Cameron themselves upon the cosmic rays is by now well known, and it is unnecessary to elaborate here upon the way in which they have applied relativity and quantum theory to enable them to trace the origin of the penetrating radiation to a creation of certain light elements from protons and electrons, except again to emphasise, with Prof. Millikan, the importance in this connexion of Dr. Aston's work with the mass-spectrograph, and of Dr. Dirac's theoretical treatment of the absorption by matter of radiation of short wave-length.

In this address, however, Prof. Millikan has dealt with two other problems raised by his own work. The first of these is the question as to where atom-building processes can proceed in the universe. His full arguments are not advanced—they are to be published in the October number of the *Physical Review*—but he states that there is excellent experimental proof that the nuclear combination which produces the cosmic rays does not take place in the stars at all, but at places of low pressure where the temperature is close to the absolute zero; in other words, in interstellar or intergalactic space. Combining this with the conclusions of Prof. Eddington and Sir James Jeans, he arrives at the picture of a continuous atom-destroying process taking place under the extreme conditions existing in the interiors of stars, and an atom-creating process taking place between the stars in the equally extreme conditions of an opposite kind obtaining there.

The second point raised, closely connected with the first, is the problem of why the primordial positive and negative electrons which go to build up the common elements have not been used up long ago. The answer which Prof. Millikan and Dr. Cameron make is "that out in the depths of space where we actually observe through the cosmic rays helium, oxygen, and silicon being continually formed out of positive and negative electrons, there too these positive and negative electrons are also being continually replenished through the conversion back into them under the conditions of zero temperatures and densities existing there, of the radiation continually pouring out into space from the stars." With the aid of this assumption, they can regard the universe as being already in a steady state, and can avoid the necessity for supposing that it must finally suffer a 'heat-death,' in contradiction to the conceptions of Sir James Jeans, who supposes that the process of conversion of mass into radiant energy is nowhere reversible (Nature, **121**, 467; 1928), and of others who suppose that the processes are all everywhere reversible.

In his concluding remarks, Prof. Millikan discusses in a general way what sources of power are likely to be used in the future, although he suggests little that is new. Any extensive application of the energy available through the disintegration of radio-active or other atoms is dismissed, as is use of the almost unlimited energy which would be obtained if the hydrogen atoms of terrestrial water could be induced to build themselves up into atoms of other elements, since it is impossible to imitate the conditions of interstellar space under controllable conditions, and he comes ultimately to the conclusion that solar energy, in some form or another, must continue to supply most human needs.

University and Educational Intelligence.

Cambridge.—The retiring Vice-Chancellor, the Rev. G. A. Weekes, announced on Oct. 1, that the University has received an offer from the International Education Board of the Rockefeller Foundation of a gift of £700,000, of which £250,000 would be for the proposed new library and the remainder "for certain new developments in the physical and biological studies of the University." The gift is conditional on the University raising the money required to complete the whole scheme. As regards the University Library, it will be remembered that provisional plans for a new building costing £500,000 for construction and maintenance have been under consideration, and the Finance Board decided that £250,000 could be raised to enable a portion of the work to be started. The Rockefeller gift of £250,000 would make it possible to proceed with the whole building at once. The remaining £450,000 is offered towards necessary developments of physical and biological studies, the complete scheme of which will cost £679,000; the University has thus to raise a further sum of £229,000 in order to be able to accept the Rockefeller gift.

London.—The following courses of free public lectures at University College are announced: "Recent Work on Vitamins," by Prof. J. C. Drummond, on Oct. 12, 19, 26, Nov. 2, 9, and 16; "Urinary Secretion," by Prof. E. B. Verney, on Oct. 15, 22, 29, Nov. 5, 12, and 19. The lecture hour will be 5 o'clock and no tickets will be required.

During the forthcoming Michaelmas term courses of lectures will be given at the British Institute of Philosophical Studies by Prof. L. J. Russell on "Four Great Philosophers and the Modern Outlook," and by the Director of Studies, Mr. Sydney E. Hooper, on "Contemporary Philosophy." Full syllabuses can be obtained from the temporary offices of the Institute, 88 Kingsway, London, W.C.2.

From the University of Colorado we have received its Annual Catalogue with announcements for 1928–29, —a volume of some 500 pages, wherein are to be found interesting illustrations of several modern American departures from the traditional idea of a university. The Summer Quarter has assumed a very prominent place among the university's activities and is an important factor in the maintenance and improvement of the standards of teaching in the schools throughout the State. The students enrolled, largely school teachers, principals, and superintendents of education, numbered in last year's summer quarter 3363, as compared with a total attendance of students during the regular academic terms of 3131. The University plant is thus kept working at full pressure almost throughout the year. The University's Extension Division, organised "to render to the State at large such public service as may lie within its power," comprises a Department of Instruction, including correspondence, class, and visual instruction, and home-reading courses, and a Department of Public Service. Among the services of this department are: industrial surveys directed towards the ascertainment of opportunities for future expansion and growth of the industries of a selected district, retail cost surveys undertaken in co-operation with retail trade associations, public utility researches, a clearing house of information for municipal officials, assistance to civic organisations by scientific investigation of stated problems and drafting bills, organising conferences and exhibitions in connexion with public health, child welfare, community recreation and juvenile delinquency, a clearing house for the newspapers of the State, maintaining contact between the editors and the organised industries, and organisation of debates in high schools. The development of correspondence study is noteworthy, the enrolment in these courses having increased steadily from 150 to 1500 in the past ten years.

Calendar of Customs and Festivals.

October 9.

St. Denys.—Patron saint of France, beheaded with others on the hill thereafter named *Mons Martyrum* (Mòntmartre). After his death, the body of the saint rose, and with the head in its hand and accompanied by the singing of a celestial choir, walked a distance of two miles until it met with a woman named Catula, in whose hand it placed the head. The saint was venerated at St. Denys, near Lyons, by a procession usually of a turbulent and disorderly character, which on one occasion, at least, gave rise to a serious tumult, in which two hundred people are said to have lost their lives.

October 10.

Jack and Joan Fair.—A statute fair for the hiring of servants of both sexes held at Christ Church in Kent. For this purpose it continued until after the second Saturday following. At these fairs it was customary for the farm servants to come into the town or village and stand about the market place until they had found an employer for the ensuing twelve months. Of these statute fairs some were held in the spring, but the greater number in the autumn in October and November. In both cases the custom is no doubt determined to a great extent by agricultural operations, even where the character of the employment is not directly dependent upon them; but there is evidence that it was also connected with the traditional opening of the year in the Celtic calendar in November.

On Oct. 10, at Liverpool, it was customary for the burgesses to hold a bear-baiting on the election of the mayor. That this was more than a mere provision for the popular sporting spirit of the day but partook of a ceremonial character, and possibly was a communal expiatory ceremony, is suggested by the fact that the bull-baiting took place at certain regular stations in the town in turn. It began at the White Cross; the bear was then led in triumph to the Exchange, and from there to the Stock Market.

A custom of an analogous character obtained at Hull, where all the dogs found running about the streets on Oct. 10 were whipped with switches. Varying explanations of the custom were offered. One was that the monks used to provide liberally for the poor who came to the fair on this date, but that on one occasion a dog stole the joint and was chased by the waiting beneficiaries. From that time forward all dogs were driven off to avert a repetition of the disaster. Another account was that once while Mass was being celebrated, the Host fell and was snatched up by a dog, which paid the penalty for its sacrilege by its immediate death, and that henceforth all dogs were persecuted on this day. The coincidence of the custom with a fair—Hull fair is still one of the few remaining great fairs in Great Britain—may, however, be taken as an indication of an origin of a less fortuitous character. The dog or some other animal was originally the scapegoat, which vicariously suffered for the community and purged their sins of the old year now drawing to its close.

October 11.

St. Ethelberga.—In the accounts of Barking Nunnery is an entry of "wheat and milk for fromité upon St. Alburg's day." Fromety appears to have been a usual dish on this day. It is also specially mentioned on occasion as one of the dishes which should form part of the harvest home supper. It may be noted that wheat which has been steeped, and then boiled and sweetened with honey over the fire, was a regular dish in Egypt on the *Asuran*, the specially holy tenth day of Muharram.

October 13.

Translation of King Edward the Confessor.—The relics of King Edward, who died on Jan. 5, 1066, and was buried at Westminster, were translated for the first time in 1102, when his body was found entire, the limbs flexible, and the clothes fresh. The Bishop of Rochester "out of a devout affection endeavoured to pluck only one hair from his head, but it stuck so firmly that he was deprived of his desire." Edward was canonised in 1161, again translated in 1163, and once more about one hundred years afterwards.

October.

In India the night of the fourteenth day of the dark half of the month Ashvin (September-October) is specially associated with black magic. In the Bombay Presidency those who are given to these practices go naked to the cemetery and cook food in a human skull as an offering to the spirits residing in the neighbourhood. Sorcerers are said to ride round the village on some mysterious conveyance. The hook-shaped instrument used by thieves in breaking through the wall of a house is made by the smith and his wife on this night. All thieves' implements made in this way ensure success. The god Kalbhairav is worshipped by low-caste people such as Dhobis, Malis, Valands, and others with special propitiatory rites in which the devotees remain nude.

On all these occasions those who perform the ceremonies and practise the rites must be naked, the state of nudity being specially associated with black magic. This, for example, is essential in the form of bewitching known in the Konkan and the Deccan as Muth-marane, when the sorcerer prepares an image of wheat flour and, worshipping it with flowers, incense, etc., places before it a lime pierced with a number of pins. When molasses is poured on the image and incantations uttered the lime disappears, going to the person whose death it is intended to procure, whereupon he falls to the ground vomiting blood. It is essential that the charmed lime should return to the sorcerer, otherwise calamity follows.

Examples of ritual nudity are by no means uncommon throughout India. In a fertility rite performed before the goddess Jhampudi and in the worship of Maruti the devotee fetched the heart or skull of a corpse from the burial ground in a state of nudity. It was an essential feature in a number of rain charms. It will be remembered that European witches stripped naked as a preparation for their Sabbath rites.

In Bihār the first sugar cane is cut on the eleventh of the bright half of the month Kārtik (October-November, the bright half being the first half), when Vishnu wakes from his four months' sleep. Some people fasten a few canes together, place a neck ring on top, pour perfumes over the bundle, and then, removing the ring, proceed to cut the canes. It is scarcely necessary to point out that this is an act of worship of an effigy of a deity analogous to the 'corn maiden.' The Chāmars of the United Provinces perform the Gāyās rite at the cutting of the cane. Stalks of the cane are bound together and a pot placed below which is quickly filled with water in the hope that the cane may be abundantly filled with sap. A fire sacrifice is made and men walk quickly round the field a number of times. A few canes are broken off, and after these have been offered on an altar or placed on a bed with an axe, shovel, or sickel, and covered with a new cloth, a fire sacrifice is made and the canes are distributed among friends.

Societies and Academies.

Paris.

Academy of Sciences, Aug. 27.—**G. Bigourdan**: The co-ordinates of the observatory of the rue Sainte-Avoye. The position of Delambre's observatory and extracts from some of his notes.—**L. Joubin**: Various octopod cephalopods from the cruises of the *Dana* in the Atlantic. Amongst the specimens collected by Prof. J. Schmidt, of Copenhagen, were the octopods described. Their peculiarities necessitate a new classification of the lower octopods.—**L. Goldstein**: The equation of probability of wave mechanics.—**Paul Mondain-Monval**: The physical properties of heterogeneous ternary mixtures. The changes in the physical properties of a mixture of ethyl and isoamyl alcohols and water in the neighbourhood of the critical point, noted by P. Brun in a recent communication, were not confirmed: the curve representing refractive index as a function of concentration shows no discontinuity.—**J. Lacoste**: The daily variation of microseismic agitation.—**N. D. Costeanu** and **Al. Cocosinschi**: The rain of ashes of April 26, 1928, at Cernauti and its neighbourhood. An analysis is given of the powder which fell.

Geneva.

Society of Physics and Natural History, June 21.—**Robert Chodat** and **Florencio Bustinza**: Pseudo-peroxidase, a new indirect ferment acting by means of hydrogen peroxide. From the results of their experiments the authors consider the pseudo-peroxidase extracted from the rhizome of *Cyperus esculentus* as a peroxidasic image of tyrosinase, just as the system peroxidase-peroxide is the image of laccase, which, like tyrosinase, is inhibited by hydrogen peroxide.—**Robert Chodat**: The phases of action of tyrosinase in the cresol blue reaction. The author and his pupils have shown that there are two phases in the action of tyrosinase on the complex *p*-cresol-aminoacid. In continuation of a work of M. Raper, according to which in the course of the oxidation a quinone is formed which is the cause of the removal of amino groups, R. Chodat has made fresh experiments which prove that only the quinone obtained by starting with *p*-cresol leads to this result.—**Alexandre Wissmer**: The trajectorial structure of the fœtal mandible in man. Up to the second month the mandible is represented by Meckel's cartilage, with a thin bony leaflet joined on. At the fourth month the existence of a fundamental trajectory is proved, which only serves as a support up to the time of birth.—**Swigel Posternak**: The limit of degradation of the lactobutyrins by trypsin. Some researches recently published by Rimington are in opposition to certain conclusions of the author: the latter has repeated his experiments on the products of the trypsin digestion of casein, and arrives at his original conclusions. He has isolated, besides the α, β, and γ lactotyrins already described, a polypeptide containing fourteen atoms of nitrogen to four atoms of phosphorus, and this represents the ultimate degradation product of the lactotyrins by trypsin. Amongst the products of hydrolysis, no oxyaminoacid is found other than serin.

Washington, D.C.

National Academy of Sciences (*Proc.*, Vol. 14, No. 7, July).—**O. G. Ricketson, Jr.**: A stratification of remains at an early Maya site. The Carnegie Institution expedition at Uaxactun, Guatemala, during the season 1928 investigated Stela 20 and an adjacent pyramid. The pyramid proved to be a secondary erection covering an earlier stepped pyramid resting on an early rubbish deposit. Stela 20 seems to have been placed in position resting on the same deposit by digging through two 'floors' laid down after the erection of the stepped pyramid. Stela 20 apparently dates from A.D. 235; the other remains are older, the stepped pyramid being the oldest Maya building known.—**Donald Statler Villars**: The degree of association of sodium vapour. Observations were made of the band spectra of a sodium-potassium alloy and the dissociation of the molecule, Na_2, calculated. Using the theoretical Sackur-Tetrode equation, the degree of association was estimated. Contrary to previous hypotheses, it was found that sodium vapour is mainly diatomic, especially at temperatures below 400° C.—**Erik G. Moberg**: The interrelation between diatoms, their chemical environment, and up-welling water in the sea, off the coast of southern California. The optimum position for diatoms in deep water during the summer of 1926 was 30-35 metres below the surface; above this level the limiting factor appeared to be lack of nitrate, whereas below it the illumination became insufficient. A certain amount of upwelling is required to maintain the environmental conditions.—**G. A. Miller**: Transformation of conjugate elements or of conjugate subgroups.—**Charles F. Craig**: Observations upon complement fixation in infections with *Endamœba histolytica*. Alcoholic extracts of cultures of this parasite, when used as antigens in a complement fixation test, appear to give a specific diagnosis of the presence of the organism. Positive reactions are given only by individuals suffering from *E. histolytica* and by healthy 'carriers.'—**Janet H. Clark**: Reversible crystallisation in tendons and its functional significance. A change of state, for example, from a liquid-liquid to a liquid-solid system, may cause changes in surface forces, which can be detected in X-ray diffraction patterns. The patterns obtained from white fibrous and yellow elastic tissue indicate that collagen and elastin exist normally as liquid crystals, but that the former undergoes reversible crystallisation on stretching the tendons. This probably increases cohesion and marks the limit of elasticity.—**G. W. Crile, Amy F. Rowland**, and **Maria Telkes**: An interpretation of excitation, exhaustion and death in terms of physical constants. Measurements of the potential difference (P.D.) between different organs and tissues in the rabbit show that physical injury, drugs, etc., cause an immediate fall in P.D., followed by some recovery; repeated or protracted excitation tends to diminish the P.D., and death occurs when the P.D. approaches zero. After death there is a secondary rise of P.D. in the brain and in voluntary muscle, but it eventually disappears, indicating complete death following clinical death.—**J. A. Bearden**: The polarisation of characteristic radiation. Monochromatic X-radiation was scattered from a graphite block at 45° to the beam, and the intensity of the scattered beam was measured parallel and at right angles to the beam. In one experiment the differences between the intensities when two different filters were used were compared; in another experiment the filters were replaced by a crystal of calcite and the graphite block rotated with the ionisation chamber. No certain evidence of polarisation was obtained.—**Carl Barus**: The repulsion between electric currents and their induced eddy currents in parallel. An attempt was made to measure the pressure on the mercury in one limb of the interferometer U-gauge due to eddy currents caused by an alternating current traversing a coil above the mercury. The results were not satisfactory.—**R. T. Cox, C. G. McIlwraith** and **B. Kurrelmeyer**: Apparent

2. long period of elements

evidence of polarisation in a beam of β-rays. β-rays were twice scattered at right angles from gold targets, and the number entering a Geiger counter were recorded as the angle between the initial and final segments of the path was varied. The essential parts are enclosed in an axial and radial channels in an upright steel cylinder, the top half of which, carrying the β-ray source and the first target, revolves about the bottom half. There is some evidence of true polarisation due to double scattering of asymmetrical electrons, which is confined mainly to the faster electrons.—**A. H. Compton**: The spectrum and state of polarisation of fluorescent X-rays. The line radiation in the spectrum of fluorescent X-rays from silver constitutes 99 per cent of the total radiation. The method is thus very useful for producing homogeneous X-rays; the β- and γ-rays can readily be filtered out, leaving practically nothing except $K\alpha$ radiation. The relative intensities and positions of the α- and β-lines is approximately the same in the fluorescent as in the primary X-rays, and the former are found to be completely unpolarised.—**G. Breit**: An interpretation of Dirac's theory of the electron. Certain terms of Dirac's theory are associated with definite physical quantities and its analogy with Pauli's formulation of the theory of the spinning electron is made more complete.—**R. C. Gibbs** and **H. E. White**: Regularities exhibited between certain multiplets for elements in the second long period. Plotting energy levels against atomic number for iso-electronic systems, lines connecting points for corresponding terms of each successive element are nearly straight lines; radiated frequencies resulting from transitions involving no change in total quantum number are displaced to higher frequencies by nearly a constant value. This applies in the first long period and is now extended to the second long period.—**Gaylord P. Harnwell**: Angular scattering of electrons in hydrogen and helium. A large scattering chamber was used with an electron gun which could be turned through nearly a complete circle. After passing through a slit in the closed end of a brass tube, the electrons were caught in a Faraday cylinder; a continuous flow method was used, the pressure in the cylinder being kept below that in the scattering chamber. With molecular hydrogen, atomic hydrogen, and with helium, a definite peak in the ionisation curve was observed as the electron gun was rotated. When, however, the inside of the chamber was given a heavy coating of magnesium, no peak appeared; the peaks therefore appear to be due to electrostatic charges inside the chamber. It is concluded that there are no favoured angles for electron scattering from these gases.—**Gilbert N. Lewis** and **Joseph E. Mayer**: Thermodynamics based on statistics. (1) It is assumed that for a system having a certain volume, energy, and number of particles, the whole field of specifications which describe the states of the individual particles is naturally partitioned into regions so as to give unique significance to a quantity, log Ω, where Ω represents the total number of different ways in which the particles may be distributed among the regions.—(2) The assumption made above leads to equations identical with those of classical thermodynamics.—**David M. Dennison**: A proposed experiment on the nature of light. Suppose a beam of high-frequency X-rays falls on a single crystal used as a diffraction grating, that the intensity of the beam is adjusted by filters so that only a few light quanta are transmitted per minute, and that Geiger counters are placed at the position of two Laue spots of equal intensity. On the classical wave theory, groups of waves will be diffracted simultaneously to all orders of reflection and the absorptions at the Geiger counters would be simultaneous; on the theory of light quanta, the absorptions would be related only by chance in such a manner that the mean energy arriving at each spot would be equal to that predicted by the wave theory.—**Egon Lorenz**: The spectrum of X-rays from the back of a tungsten target. Under the influence of the electric field, an electron beam hitting a target makes the latter a source of new electron rays ('reflected' rays), which hit the anode over its whole length; the total amount of such radiation is about 24 per cent of the focal spot radiation. With a tungsten anode it is produced mostly by secondary electrons knocked out from the levels of the tungsten atom, and the probability that absorption takes place is a function of the voltage applied to the tube.—**A. P. R. Wadlund**: Absolute X-ray wavelength measurements. A speculum grating with space $2 \cdot 0000 \times 10^{-3}$ cm. was used, and measurements were made at small glancing angles of the $K\alpha_1$ lines of copper, iron, and molybdenum.—**F. Zwicky**: On the thermodynamic equilibrium of the universe. Although the postulate is not justified so far as the distribution of radiation and the equilibrium between matter and radiation is concerned, a consistent statistical treatment of the equilibrium of different forms of matter on the basis of this postulate promises to furnish results agreeing with the facts.—**David White**: Algal deposits of Unkar Proterozoic age in the Grand Canyon, Arizona. Four forms of deposits, referred to blue-green algæ, and two or three doubtful of origin, are recognised.

Official Publications Received.

British.

First Report of the Joint Advisory Committee on River Pollution. Pp. 8. (London: H.M. Stationery Office.) 2*d*. net.

Imperial College of Science and Technology, South Kensington, London, S.W.7. Department of Aeronautics: Session 1928–29. Pp. 7. (London.)

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1127 (Ae. 299): Further Development of Autogyro Theory. Parts 1 and 2. By C. N. H. Lock. (T. 2416 and a.) Pp. 43+2 plates. 1*s*. 9*d*. net. No. 1159 (Ae. 324): A Theoretical Estimate of the Pressure Gradient in a Wind Tunnel. By H. Glauert. (T. 2602.) Pp. 11. 6*d*. net. (London: H.M. Stationery Office.)

Australasian Antarctic Expedition, 1911–1914. Scientific Reports. Series C: Zoology and Botany. Vol. 8, Part 4: The Bryozoa. Supplementary Report. By Arthur A. Livingstone. Pp. 93+7 plates. (Sydney, N.S.W.: Alfred James Kent.) 10*s*.

Colony and Protectorate of Kenya. The Forest Department Annual Report, 1927. Pp. 35. (Nairobi.)

The East London College (University of London). Calendar, Session 1928–1929. Pp. 191. (London.) 1*s*.

Education, India. Education in India in 1925–26. Pp. iv+157. (Calcutta: Government of India Central Publication Branch.) 10 annas; 1*s*.

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 1, No. 3: The Geology of the Highland Border from Tayside to Noranside. By Dr. Douglas A. Allan. Pp. 57-88+2 plates+1 map. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 5*s*. 6*d*.

Reports on the Organisation and Economic Aspects of Agricultural Research in various Countries. By Dr. Alexander Nelson. Pp. iii+116. (Hobart, Tasmania: Agricultural and Stock Department.)

Proceedings of the South London Entomological and Natural History Society, 1927–28. Pp. xx+125+8 plates. (London.) 12*s*. 6*d*.

Transactions of the Leicester Literary and Philosophical Society, together with the Council's Report and the Reports of the Sections, 1927–28. Vol. 29. Pp. 60. (Leicester.)

Foreign.

Cornell University: Agricultural Experiment Station. Memoir 110: The Effect of Freezing on the Respiration of the Apple. By D. B. Carrick. Pp. 28. Memoir 112: A Survey of Sickness in Rural Areas in Cortland County, New York. By Dwight Sanderson. Pp. 27. Memoir 113: Studies of Protein Metabolism, Mineral Metabolism and Digestibility with Clover and Timothy Rations. By L. A. Maynard, R. C. Miller and W. E. Krauss. Pp. 33. Bulletin 460: Bacteria Count Limits and the Transportation of Milk. By James D. Brew and Richard C. Fisher. Pp. 37. Bulletin 462: Economic Studies of Dairy Farming in New York. viii: Grade B Milk with Cash Crops and Mixed Hay Roughage, Crop Year 1924. By E. G. Misner. Pp. 38. Bulletin 464: An Economic Study of Certain Phases of Fruit Marketing in Western New York. By Roger B. Corbett. Pp. 51. (Ithaca, N.Y.)

United States Department of Agriculture. Technical Bulletin No. 52: A Classification of the Higher Groups and Genera of the Coccid Family Margarodidae. By Harold Morrison. Pp. 240+7 plates. (Washington, D.C.: Government Printing Office.) 50 cents.

Proceedings of the United States National Museum. Vol. 73, Art. 14: Fire-Making Apparatus in the United States National Museum. By Walter Hough. (No. 2735.) Pp. 72+11 plates. Vol. 73, Art. 17: Field Notes on Vertebrates collected by the Smithsonian-Chrysler East African Expedition of 1926. By Arthur Loveridge. (No. 2738.) Pp. 69+4 plates. Vol. 73, Art. 18: Two new Species of Commensal Copepods from the Woods Hole Region. By H. R. Seiwell. (No. 2739.) Pp. 5+2 plates. Vol 73, Art. 19: New Moths of the Family Ceruridae (Notodontidae) in the United States National Museum. By William Schaus. (No. 2740.) Pp. 90. Vol. 73, Art. 21: Concerning the Origin of the Metal in Meteorites. By George P. Merrill. (No. 2742.) Pp. 7+3 plates. Vol. 73, Art. 23: Notes on American Two-winged Flies of the Family Sapromyzidae. By J. R. Malloch. (No. 2744.) Pp. 18. Vol. 73, Art. 24: A new Pterosaurian Reptile from the Marine Cretaceous of Oregon. By Charles W. Gilmore. (No. 2745.) Pp. 5. (Washington, D.C.: Government Printing Office.)

Japanese Journal of Mathematics. Transactions and Abstracts. Vol. 5, No. 1, June. Pp. 125. (Tokyo: National Research Council of Japan.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 11, No. 4, July. Pp. 205-301+13 plates. (Tokyo and Kyoto: Maruzen Co., Ltd.) 2.00 yen.

CATALOGUES.

Mycologia: Plantarum Pathologia. Supplementum: Scripta Botanica Miscellanea. (No. 73.) Pp. 54. (Berlin: W. Junk.)

A Short List of Old and Modern Books on Gardening, Horticulture, Botany; including a Selection of Herbals, also Books of Flower Drawings. (No. 509.) Pp. 12. (London: Francis Edwards, Ltd.)

The Taylor-Hobson Outlook. Vol. 3, No. 10, September. Pp. 8. (Leicester and London: Taylor, Taylor and Hobson, Ltd.)

Spectrometric Apparatus (Spectrographs). Pp. 12. Spectrocomparators. Pp. 4. (London: Bellingham and Stanley, Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 5.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers Club, Manchester), at 7.—Dr. W. Hubball: The Chemist and his Message.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. J. Simpson: Interesting Details of Swiss Alpine Railways.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at College of Technology, Leicester), at 8.—C. Ainsworth Mitchell: Some Notable Trials involving Chemical Evidence.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Society of Chemical Industry—London Section) (at Royal Society of Arts).—F. H. Rogers: Factory Floors.

SATURDAY, OCTOBER 6.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Joint Meeting of the South Wales District and the Institution of Civil Engineers (South Wales Association)) (at Cardiff), at 10.15 A.M.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Western District Meeting) (at Town Hall, Stockport), at 11 A.M.

BIOCHEMICAL SOCIETY (in Biochemical Laboratory, Cambridge), at 2.30. —A. V. Szent György: (*a*) Functions of Peroxidase Systems; (*b*) Chemistry of the Adrenal Cortex.—E. H. Lepper and C. J. Martin: A Thermostable Autoxidisable System comprised of Boiled Muscle and Hæmochromogen.—B. Woolf: The Estimation of Ammonia, Urea, and Total Nitrogen.—F. T. Grey: The Behaviour of Glucose in Urine.—T. A. Webster and R. B. Bourdillon: Observations on the Irradiation of Ergosterol.—Dr. A. S. Parkes and G. F. Marrian: Observations on the Distribution of Oestrin.—H. D. Kay and P. G. Marshall: The Second Protein (Livetin) of Egg-yolk.—E. Stedman: The Miotic Activity of the Urethanes derived from the Isomeric Hydroxybenzyldimethylamines.—H. J. Holman and Dr. S. B. Schryver: The Separation of the Basic Products of the Hydrolysis of Proteins.—Dr. L. J. Harris: The Zwitterion Constitution of the Amino-acid Molecule. Titration Curves of Methylene Derivatives.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 3.45.—E. Longden: Presidential Address.—Prof. F. Johnson: Oxygen and Metals: Some Features in their Relationship.

MONDAY, OCTOBER 8.

ROYAL SOCIETY OF MEDICINE (War Section), at 5.—Lieut.-General Sir Matthew Fell: The War Section (Presidential Address).

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—L. H. Hounsfield: The Integrity of the Technical Man.

CERAMIC SOCIETY (Pottery Section) (at North Staffordshire Technical College, Stoke-on-Trent), at 7.30.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—S. E. Flack: Chairman's Address.

INSTITUTE OF BREWING (London Section) (at Charing Cross Hotel).—F. W. Cooke, A. Hadley, H. Lloyd Hind, and others: Discussion on Season's Malts (made from 1927 barley).

TUESDAY, OCTOBER 9.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall), at 6.45.—Dr. H. M. Vernon: Methods of Heating and Ventilating Schools and their Influence on Health.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. J. A. Smythe: Chairman's Address.

QUEKETT MICROSCOPICAL CLUB, at 7.30.

WEDNESDAY, OCTOBER 10.

INSTITUTE OF FUEL (at Chemical Society), at 6.—T. A. Peebles: Automatic Combustion Control of Liquid, Solid, and Gaseous Fuels.

BRITISH HOROLOGICAL INSTITUTE (Annual Meeting) (at 35 Northampton Square, E.C.1), at 6.30.—Sir Frank Dyson: The History of the Royal Observatory.

INSTITUTE OF METALS (Swansea Local Section) (in Thomas' Café, Swansea), at 7.—J. H. Grant: Chairman's Address.

EUGENICS SOCIETY (at Royal Society), at 8.30.—L. H. D. Buxton: Primitive Marriage Customs and Inbreeding.

CERAMIC SOCIETY (Building Materials Section) (at North Staffordshire Technical College, Stoke-on-Trent).—A. B. Searle: Modern Facing Bricks.—C. Presswood: Thermal Insulation.—Pragos Engineering Company: Modern Brick Machinery and Works Layout.

THURSDAY, OCTOBER 11.

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7.30. —Dr. S. W. Smith: Chairman's Address.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Col. J. W. Gifford: Lenses and Equipment for Ultra-violet Photography.—Dr. H. Boegehold: Some Remarks on Old English Objectives.—T. H. Court and Prof. M. von Rohr: On the Development of Spectacles in London from the End of the Seventeenth Century.

FRIDAY, OCTOBER 12.

DIESEL ENGINE USERS' ASSOCIATION (at 19 Cadogan Gardens, S.W.), at 5.30.—S. B. Freeman: Marine Oil Engines.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. Squirrell: The Use of Instruments in the Boiler-House.

INSTITUTE OF METALS (Sheffield Local Section) (in Non-Ferrous Section, Applied Science Department, Sheffield University), at 7.30.—R. D. Barklie: Alternating Current Electrolysis.—Dr. E. B. Sanigar: Sodium Cyanide in Silver Plating.

SATURDAY, OCTOBER 13.

MINING INSTITUTE OF SCOTLAND (at Glasgow).

PHYSIOLOGICAL SOCIETY (in Physiology Department, Guy's Hospital Medical School).

PUBLIC LECTURES.

THURSDAY, OCTOBER 4.

UNIVERSITY COLLEGE, at 2.30.—Sir Flinders Petrie: History of Decoration.

SATURDAY, OCTOBER 6.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. R. Ogden: The Recent Discoveries at Ur of the Chaldees.

MONDAY, OCTOBER 8.

UNIVERSITY COLLEGE, at 5.15.—Dr. R. E. M. Wheeler: Recent Work in British Archæology.

WEDNESDAY, OCTOBER 10.

UNIVERSITY COLLEGE, at 5.—Dr. P. Hopkins: The Comparative Psychology of Oriental Religions.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Miss S. M. Fry: Penal Reform (Stevenson Lecture).

SATURDAY, OCTOBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Davis: The Animal Conquest of the Sea.

CONGRESS.

OCTOBER 9–11.

FRENCH CONGRESS OF LEGAL MEDICINE (at Paris).—Prof. Balthazar: Expert Evidence in Social Questions.—MM. Charbonnel and Massé: Industrial Accidents, Comparative Results of External Methods and Osteosynthesis in the Treatment of Fractures of the Leg.—M. Duvoir: Professional Intoxication by Hydrocarbides.—M. Fribourg-Blanc: Anti-social Reactions in Epidemic Encephalitis.

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