SATURDAY, MARCH 7, 1931.

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

No. 3201, VOL. 127]

Scientific Method in International Affairs.

THERE is a widespread tendency to hold science, and possibly chemistry in particular, responsible for many of the worst evils of modern warfare, which is perhaps the more dangerous to society because it is apt to discredit the voice of science. When a distinguished chemist like Dr. H. Levinstein points out that attempts at chemical disarmament or the abolition of chemical warfare, except as part of a general disarmament plan, are largely futile and may be highly dangerous because of the close relationship between chemical warfare and the ordinary operations of chemical industry, he is straightway charged in some quarters with a fatalistic war mentality.

When the charge against science is examined a little more closely, its gravamen will be found to reside in part in the prejudices of those whose deep-rooted habits and instincts have been disturbed by the impact of scientific discovery. Not only have the character and potentialities of warfare been transformed by scientific discoveries and their industrial development, but also scientific methods of transport and of sanitation have enormously enlarged its scale and scope. The ramifications of modern warfare extend so deeply into the fabric of industrial life that all distinction between combatant and non-combatant has largely disappeared.

It is essentially applied science that has made warfare a matter no longer of armies and navies but of whole populations, and this and the failure of defensive measures to keep anything like pace with the development of offensive weapons have forced on civilisation the realisation that we must learn alternative methods of settling our international disputes or face the probability of the destruction of civilisation. The supreme lesson of the War is that war between the highly civilised nations has been industrialised, and by its all-embracing needs has ceased to be a directable instrument af policy.

When the control and direction of war are no longer in the hands of statesmen, its renunciation as an instrument of national policy becomes inevitable. Fundamentally, it is true that just as the growth of modern science changed human relationships and, finally, by mastering the forces of Nature, made slavery an anachronism, so it has now changed the relations and policies of nations and challenges society to find a substitute for war. Beneath this challenge there lies man's imperative need of retaining or securing intelligent control

over social forces if he is to continue to be master of his fate, and of finding new methods now that the danger and inadequacy of the old are revealed.

While, however, most thoughtful men have welcomed the renunciation of war as an instrument of national policy, only the foolish or fanatical imagined that international disputes or causes of war would forthwith disappear. The problem of peace is, in truth, exceedingly complex. Not all the world is civilised, nor all that claims to be, and in the uncivilised condition of the world, war has formerly been an instrument against criminal aggression as much as it has been such an instrument itself. There is need for the development of a science of peace: not merely the elaboration of alternative methods of settling international disputes, but also the scientific study and impartial examination of all the complex factors, economic, social, political and racial, involved in controversial problems which are sources of international friction and possible *casus belli*, if the Pact of Paris is to be transformed from a pious hope or gesture into an abiding and dominant factor in international relations. It is primarily from science that society must learn scientific principles and methods of unravelling such problems and reducing them to their elements, and the responsibility for constructive thought and statesmanship is one from which scientific workers cannot escape.

A striking example of the efficacy of such scientific methods when applied to international affairs is to be found in the Pacific. The impartial research carried out during the last five years by the Institute of Pacific Relations on such delicate matters, involving embittered national feelings, as the South Manchurian railway, the exclusion of Japanese immigrants from California, extra-territoriality in China, have transformed the menacing problem of the Pacific into one that promises to yield to treatment that is essentially scientific. Research into questions like food and population in their bearing on emigration and immigration, for example, has done much to facilitate the settlement of acute problems on the basis of facts and not of prejudice with its evitable friction. So successful, indeed, has been this method that when the volumes recording the preparatory work of the Kyoto Conference of the Institute were presented at Geneva last year, the Secretary-General of the League of Nations expressed the hope that this method of dealing with dangerous issues might soon be applied to Europe.

As a direct outcome of this work of the Institute of Pacific Relations, Prof. J. T. Shotwell, its research director, worked out during the same Assembly a scheme for a European institute of research constituted on similar lines. This institute is intended to apply the spirit and technique of scientific inquiry to the economic and social problems incidental or inimical to a civilisation of peace. It will be non-political, and its aims are to study the social, economic, and cultural problems common to various nations, more particularly the problems arising from invention and discovery; to extend international co-operation in this field; to co-ordinate the results of research and, in the light of the facts thus found, in concert to investigate the underlying causes of international difficulties. Its functions will be solely those of research and publication of the facts as ascertained.

Although the importance of this proposal was recognised by the delegates of several nations, it has yet to receive official recognition and discussion. The scheme must commend itself to all scientific thinkers as a sane alternative to our present method of handling controversial questions and allowing them to be inflamed by partisan propaganda. It is a method by which science can assist society through the dangerous interval between the renunciation of war, as too dangerous an instrument, and the firm establishment of other methods of dealing with international disputes.

Already the technique and efficiency of conference are being steadily perfected. The proposed institute offers a fair prospect of eliminating political propaganda and reaching agreed settlements as a result of scientific inquiry. It opens fields of constructive activity before the Institute of Intellectual Co-operation and before such national institutions as the W. H. Page School of Historical Research and the Royal Institute of International Affairs in Great Britain. However unjustly science has been blamed for the misuse of scientific discoveries, scientific men have not always been fully mindful of their responsibility as citizens. No opportunity like the present has, however, yet confronted them of promoting the scientific study of international relations and ensuring the use of science for constructive purposes. Wisely used and directed, the projected institute of research may demonstrate that the humanising effect of scientific thought on *res publica* is no less profound than its application in industry. That quest for truth which inspires every scientific investigator supplies also the driving force for this experiment: *Magna est veritas et praevalebit!*

Letters to the Editor.

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Diamagnetism, Field Strength, and Crystal Structure.

RATHER a long time ago,[1] I directed attention to the fact that there seemed to exist a correlation between the following three properties of a metal: (*a*) the crystal system to which the metal belongs, (*b*) the change in electrical resistance of the metal in a magnetic field, (*c*) the diamagnetic susceptibility, and possibly (*d*) the Hall effect.

As an example I gave the following data:

	$\chi \cdot$	
Bismuth . . .	$-1{\cdot}40 \times 10^{-6}$	hexagonal
Graphite . . .	-5	
Antimony . . .	$-0{\cdot}815$	
Tellurium . . .	$-0{\cdot}303$	
Cadmium . . .	$-0{\cdot}185$	
Zinc	$-0{\cdot}151$	
Silver	$-0{\cdot}201$	regular
Gold	$-0{\cdot}152$	
Lead	$-0{\cdot}120$	
Copper . . .	$-0{\cdot}085$	

Beginning with bismuth and ending with copper, the metals are given in the order of biggest change of resistance in the magnetic field. In the same paper I came to the conclusion, when reviewing the results of D. E. Roberts[2] on the change of resistance of graphite in the magnetic field, that the so-called free electrons could not be made responsible for the conductivity in this case, as the electrons clearly do not show any influence of a Lorentz force acting on them, which should be impossible in the case of the electrons being free. It followed that the electrons have to go from one atom to another one: that is, they are almost entirely bound, as in the case of graphite, or partly bound, as in the other metals. One would say now that it is clear that the outer electrons of the atoms are responsible for a big part of the electric conductivity, and at the same time they are in a large way responsible for the diamagnetic susceptibility. In the case of bismuth, the fact that the directions of maximum change of conductivity and of maximum susceptibility are at right angles indicates this still more strongly.

As seen, those views were derived immediately from the direct results of measurements, yet they do not seem to have attracted much attention. No idea, however, was offered as to the meaning of the relationship. In this respect, during the last few years, following the same mode of reasoning, Ehrenfest has made some useful suggestions in his papers on the diamagnetic susceptibility of bismuth.[3] For this substance he states a working hypothesis agreeing with the views mentioned above, and giving at the same time an explanation of the very big value of the diamagnetic susceptibility of bismuth. As is well known, he explains the extraordinarily high susceptibility of bismuth by the fact that in this metal the outer electrons do not move around a single atom but around several of them. The surface of their orbits is then large, and hence there is high susceptibility. It seems to me that this theory is a very valuable help in understanding the results of the susceptibility measurements.

It was the idea of 1914 that made us undertake new measurements. Mr. Schubnikow and I had found that the change of resistance of highly purified bismuth is a very complicated function of field strength and orientation of the axes at low temperatures. Now here we can decide whether such a relationship as mentioned does exist really for bismuth: the diamagnetic susceptibility up to now had always been found to be a very simple and regular function of the field strength and the orientation of the axis.[4] If the

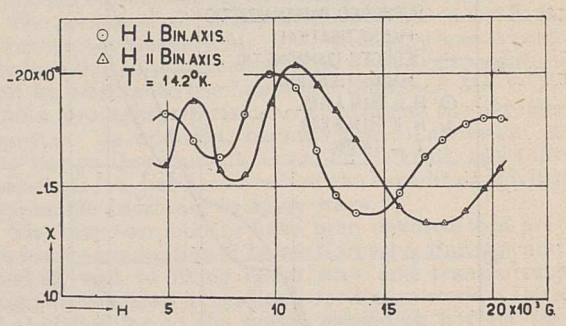

FIG. 1.

suggested relationship exists, this should no longer be the case for crystals that show a complicated change of resistance. We have had some very pure crystals grown, and Mr. Van Alphen and I have measured their susceptibility as a function of the field strength at 14° K. and 20° K. The result was in quite good agreement with our reasoning. This will be seen from the accompanying graphs, which we publish without drawing further conclusions from them. Fig. 1 gives the susceptibility as a function

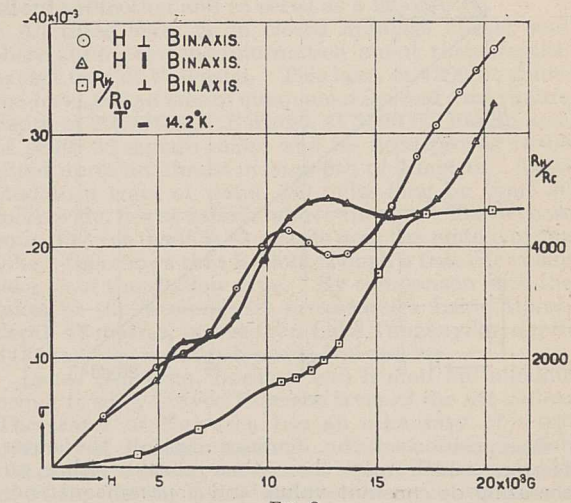

FIG. 2.

of the field. In Fig. 2 the magnetisation curves of bismuth are given. In the same graph the curve is given indicating the change of resistance of bismuth with the field strength (already described by Schubnikow and De Haas[5]). It is clear that the curve showing change of resistance, indicated by ⊡, and the curve showing the magnetisation, indicated by △, are closely related: in fields where the resistance increases, the magnetisation remains nearly constant; where the magnetisation increases, the resistance remains constant. This seems to indicate the double part played by the outer electrons: when adding

much to the susceptibility, they do not change the resistance, and vice versa.

Though I am not able to give a suggestion of a theory which would be capable of predicting the curves, there is one remarkable fact to which I wish to direct attention, and for which I should like to suggest a possible explanation. The curves not only show parts where the magnetisation remains constant in an increasing field, but also where this value even decreases. It seems to me that this may be due to

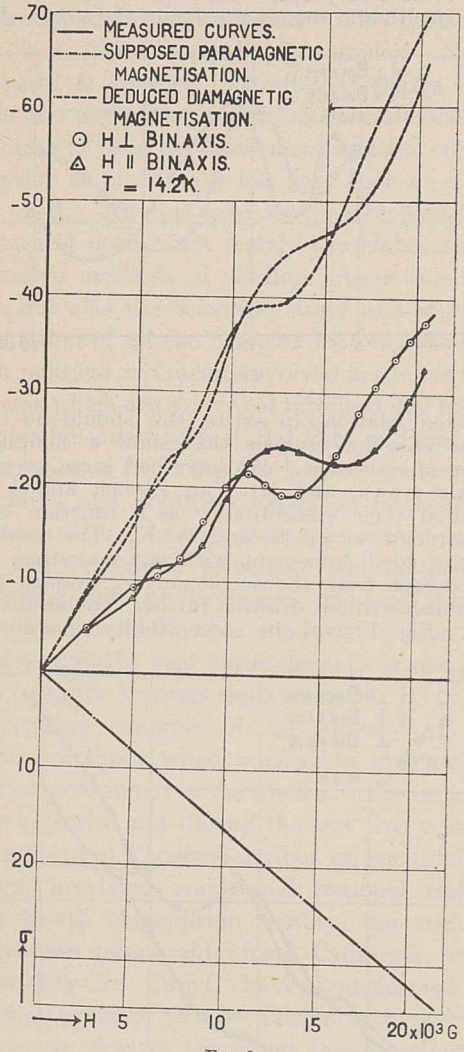

FIG. 3.

a superposition of the diamagnetism of the outer electron, which may show then always either an increasing or constant value, and a paramagnetism, due to the rest of the atoms, which would show a steadily increasing value. Fig. 3 indicates this theory: the straight line gives the supposed paramagnetic magnetisation. From this and from the measured curves (which are the same as in Fig. 2) the upper curves, giving the supposed behaviour of the diamagnetic magnetisation, are deduced. The fact that only at very low temperatures does the decrease of magnetisation take place would be due to the fact that at higher temperatures the paramagnetism (which might be supposed to follow to a first approximation the Curie law) is still too small to have this influence. In support of this suggestion it may be noted that whereas the diamagnetism increases rather much from room temperature to the boiling-point of hydrogen, no further increase takes place between the boiling-point and the triple point: the increase of diamagnetism would be compensated for in this region by the increase of the paramagnetism. The increase in diamagnetism may be due to the fact that the large orbits of the Ehrenfest theory are disturbed at higher temperatures: the larger temperature motion of the atoms in the lattice may account for this; the large motions of the atoms caused by the melting of the metal destroys them entirely. However, the mean paramagnetic moment of the rest of the atom would have to be small in order to show the right value of magnetisation in the temperature region of liquid hydrogen. Anyhow, further work at the temperatures of liquid helium will bring more light in these questions.

W. J. DE HAAS.

University of Leyden.

[1] W. J. de Haas, *Proc. Royal Acad. Amsterdam*, vol. 16, p. 1110; 1914. W. J. de Haas, *Kon. Akad. v. Wet. Amsterdam*, versl. 22, p. 90; 1914.
[2] D. E. Roberts, *Ann. d. Phys.*, **40**, p. 453; 1913.
[3] P. Ehrenfest, *Physica*, **5**, p. 388; 1925; and *Zeit. f. Phys.*, **58**, p. 719; 1929.
[4] J. C. McLennan and E. Cohen, *Trans. Roy. Soc. Canada*, **23** (section 3), 159; 1929.
[5] L. Schubnikow and W. J. de Haas, NATURE, **126**, p. 500; 1930.

Change of Resistance in Magnetic Fields.

UNTIL recently, the theory of conductivity put forward by Sommerfeld and Bloch did not succeed in explaining the change of resistance in magnetic fields. If R' is the resistance in a magnetic field H, R that without magnetic field, then for weak fields the change of resistance $\Delta R = R' - R$ follows theoretically as well as experimentally the law [1]

$$\Delta R/R = B \,.\, H^2. \quad . \quad . \quad . \quad (1)$$

The absolute magnitude, however, of the coefficient B was found experimentally to be about 10,000 times greater than Sommerfeld's theoretical value. But according to Peierls,[2] one can obtain the right order of magnitude for the magneto-resistance effect by taking into account that the electrons in a metal are not moving freely, but are strongly influenced by the potential of the metal atoms. Peierls gets the result

$$B = B' \,.\, \kappa \,.\, \left(\frac{E_0}{kT}\right)^2 \quad . \quad . \quad . \quad (2)$$

where B' is the value of B calculated by Sommerfeld,[3] E_0 is the limit energy of the Fermi-Dirac distribution of the conductivity electrons, which is about 300 times as big as kT for room temperature, and κ is a constant which measures the deviation of the motion of the conductivity electrons from field-free motion. In single crystals κ depends on the direction both of the applied magnetic field and of the current relative to the crystal axes, but not on the temperature. The value of κ required to explain the experiments is about 0·1, which seems reasonable, whereas the exact theoretical value cannot be calculated at present.

A check of the theory can, however, be made by considering the temperature dependence of the magneto-resistance effect. Inserting Sommerfeld's value for B' and E_0,[4] we get

$$B = \frac{\pi^2}{12} \cdot \frac{1}{(en)^2} \cdot \kappa \cdot \frac{1}{R^2}. \quad . \quad . \quad (3)$$

Here all factors on the right-hand side are independent of the temperature except the specific resistance R. As regards dependence on temperature, therefore, the relative change of resistance in a given magnetic field is inversely proportional to the square of the resistance; the absolute change is inversely proportional to the resistance itself. The same result may be obtained by a more exact calculation, using Bloch's conductivity

theory. If B_0 and R_0 refer to room temperature and B and R are measured at any other temperature, we have from (3)

$$B_0 = B\left(\frac{R}{R_0}\right)^2. \quad . \quad . \quad . \quad . \quad (4)$$

The two last columns of the accompanying table are calculated according to (4) and show a good agreement

VARIATION OF B WITH TEMPERATURE.

	Kapitza's observations at the temp. of:				$B \times 10^{12}$ at room temperature.		
	CO_2 + ether.		Liquid nitrogen.		Obs. by Kapitza.	Deduced by Equ. (4) from experiments at temp. of:	
	$B \times 10^{12}$.	R/R_0.	$B \times 10^{12}$.	R/R_0.		CO_2 + ether.	Liquid nitrogen.
Mg	4·9	0·68	55	0·17	2·15	2·25	1·6
Zn	1·87	0·68	19·7	0·19	—	0·87	0·72
Cd	6·6	0·68	33	0·22	—	3·0	1·6
Mo	1·28	0·61	15·4	0·136	—	0·46	0·29
Be	—	—	40·4	0·33	9·8	—	4·4
Ga	25	0·65	174	0·21	—	10·3	7·8
As	50	0·6	470	0·16	16·4	18	12

between each other and the directly observed value of B_0 given in the preceding column.

H. BETHE.

Cambridge.

[1] For the theoretical explanation of the deviation from this law for strong fields observed by Kapitza (*Proc. Roy. Soc.*, A, **123**, 292; 1929) see N. H. Frank, *Zeit. f. Physik*, **63**, 596; 1930.
[2] Leipziger Vorträge, 1930, p. 75, see specially p. 85.
[3] *Zeit. f. Physik*, **47**, 1; 1928.
[4] See Sommerfeld, l.c., equations (77*a*), (34), (42*a*), (48*c*). Our E_0 is Sommerfeld's kT log A, n is the number of electrons per cm.^{3} of the metal.

Faraday's First Successful Experiment on Diamagnetism.

IN my discourse on "Tyndall's Experiments on Magne-crystallic Action", delivered at the Royal Institution on Friday, Jan. 21, 1927, and published as a supplement to NATURE of May 7 of that year, I gave a short account of Faraday's first successful experiment on diamagnetism. He used a piece of heavy glass which he described in his Diary as No. 174. At that time I searched through all the specimens of Faraday's heavy glass in the Royal Institution but was unable to find it. It has just turned up, being contained in a box which Mrs. Tyndall has most kindly allowed me to examine.

The box was presented to Prof. and Mrs. Tyndall by Faraday, and it contains a number of specimens which the latter used in this series of diamagnetic experiments. This piece of glass is actually the first object in which Faraday found diamagnetism to be shown.

Mrs. Tyndall has kindly promised that the box and its contents shall be on show at the Faraday Centenary Exhibition in the Albert Hall next September.

W. H. BRAGG.

The Royal Institution,
21 Albemarle Street,
London, W.1, Feb. 17.

Cambridge Expedition to the East African Lakes.

THE expedition, which is being financed by scientific societies and the University, left England in October and is at work on the rift valley lakes of Kenya. The object of the expedition is twofold: First, to continue studies on the ecology of the East African lakes which were started by the Government fishing surveys of Lakes Victoria, Albert, and Kioga in 1927–28, and at the same time to make thorough collections of the faunas of Lakes Rudolf, Baringo, and Edward, which have previously received only a cursory scientific examination; secondly, by studying the old lake beaches and deposits, to continue farther north the investigations made around Lakes Nakuru, Elmenteita, and Naivasha by Mr. L. S. B. Leakey and the biologists of the East African Archæological Expedition. It is hoped to link up evidence from lake beaches, the distribution of the present lake faunas, and the chemical constitution of the waters into a unified whole, and so to work out, so far as possible, the previous distribution of land and water during the pluvial periods.

The personnel of the expedition consists of Dr. E. B. Worthington (leader), Mr. L. C. Beadle, whose special study is that of the chemical constitution of the waters and its relation to the fauna and flora, and Mr. V. E. Fuchs, geologist, who is concentrating on the old lake beaches. In addition, through the collaboration of the Kenya Government, Capt. R. E. Dent, assistant game-warden, has accompanied the expedition, giving invaluable assistance in many ways.

The first two months have been devoted to a preliminary examination of Lakes Naivasha, Baringo, and Rudolf, and to fixing camp sites and transporting boats to the lakes in readiness for future work. Lake Rudolf lies far to the north, extending beyond the Kenya-Abyssinia border. Some difficulty was experienced in transporting the equipment and a 20-foot metal life-boat, lent to the expedition by the railway authorities, the 260 miles beyond the railhead to the lake. This is the second boat to have reached Lake Rudolf; the first having been lost some years ago, soon after her first cruise. The lake is low-lying in a wide desert area, so that the climate is hot, the daily shade temperature reaching 100° F. Living under canvas is uncomfortable owing to the heat, the bad water, and the high winds prevailing. Consequently a hut has been constructed out of local materials to afford protection and to serve as a laboratory.

All three lakes lie in closed drainage basins, and there is no previous information about their depths, except that of Naivasha. This lake, at 6200 ft. above sea-level, has an area of 60 square miles and a maximum depth of 20 metres. Baringo, at 3000 ft., has an area of some 50 square miles, and its floor proves to be silted up to an almost even depth of 7 metres. Lake Rudolf, a tract of water 180 miles long by some 30 miles wide, lies at 1400 ft. above the sea. The deepest sounding yet made is 63 metres near the middle of the lake; this shows that Rudolf, though a true rift valley lake, is of the shallow type. By comparison with the lakes of the western rift it resembles Lake Albert, depth 47 metres, rather than Lake Tanganyika, depth 1435 metres, or Lake Nyassa, 786 metres.

Lakes Naivasha, Baringo, and Rudolf are alkaline owing to soda derived from the lavas of the rift valley. The water of Naivasha has an alkalinity of 0·003 normal, of Baringo 0·005 *N.*, whereas Lake Rudolf consists of a strong solution of soda with a normality of 0·023. In the latter lake the concentration of soda salts due to evaporation and the recent lowering of the lake level have caused precipitation of lime from the water. This can be associated with the deposition of calcareous tufa some distance above present lake level, and also must have had its effect on the constitution of the lake fauna.

Concerning the faunas, Lake Naivasha, having a single small indigenous fish, *Haplochilus antinorii*, and lying in a populated area, has for the last five years been the seat of an experiment on the introduction of other fishes for commercial and sporting purposes. This must have altered the ecology considerably, and it may have caused the extermination of some small members of the invertebrate fauna. The present

fauna of Lake Baringo is poor, but shows affinities with that of Lake Rudolf to the north. Rudolf has a rich fish fauna, showing marked similarity to that of Lake Albert in Uganda and of the Lower Nile. This is proof that the lake was formerly connected to the Lower Nile system, although the present watershed between the lake basin and the Sobat tributary of the White Nile is many hundred feet above the lake level. Lake deposits over a wide tract of desert country near by and a beach at 550 ft. above present lake level show definitely that the lake was previously of much larger extent than at present. By correlation of the beach levels and by further comparison of the living and fossil faunas, it is hoped to produce important evidence concerning the pluvial periods.

The next few months will be occupied by further work on these three Kenya lakes. Later in the year the expedition will move to Lakes Edward and George, by arrangement with the Uganda Government.

E. B. WORTHINGTON.

Jan. 19.

The Antiquity of New Caledonia.

I HAVE just received from my friend M. Lucien Berland a very interesting discussion of the spider fauna of New Caledonia, with special reference to its origin.[1] It is stated that M. Piroutet (1917) has published a detailed account of the stratigraphy of New Caledonia, in which it is established that the island was entirely submerged about the end of the Eocene. The spiders, which were described by Berland in 1924, if we add a few later records, number 153 species from New Caledonia and the adjacent (and faunally similar) Loyalty Islands. These include nine endemic genera, and no less than 95 endemic species. It is suggested that this fauna, or rather its ancestors, reached the island during Oligocene time. Since then, various oscillations have occurred, but the island has not been completely submerged. The close resemblance of the fauna of the Loyalty group clearly indicates connexion with New Caledonia in comparatively recent times.

If it could be certainly established that New Caledonia received its fauna and flora not earlier than the Oligocene, we should have a very interesting means of estimating the subsequent rate of diversification and evolution. But after long consideration of the subject, both when in New Caledonia and while later working on the collections secured, I do not believe that M. Piroutet's postulate can be upheld. The central part of the island is elevated, with steep slopes, and it is quite probable that the whole surface, which may have been above the sea during Eocene times, has been removed by denudation. In such case the present stratigraphy could not well be made to prove the theory of complete submergence. But setting aside the geological evidence, I think the character of the biota accords much better with the theory of a very ancient island, formerly connected or nearly connected (presumably north-westward) with continental areas, undergoing great changes of level, and at times nearly but not completely submerged.

On any other basis it would be difficult to account for the very remarkable flora and no less remarkable molluscan fauna. Rocks in the interior are considered to be of Triassic and Cretaceous age, and while their existence does not refute the theory of submergence, there was apparently a land mass during at least a large part of the Mesozoic. The flora, studied by Compton, Schinz, Guillaumin, and others, is of such a character that Prof. Seward was led to remark: "In some respects the vegetation of New Caledonia carries us further back in the history of plants than almost any other part of the world". Guillaumin (1922) estimated the endemism of the flora as 76·5 per cent; Compton's collections, made so recently as 1914, added ten new genera and 230 new species. Resemblance to the flora of Australia is shown by the presence of such woody genera as *Callistemon*, *Kermadecia*, *Hibbertia*, *Grevillea*, *Stenocarpus*, and *Casuarina*. Strangely enough, there is not a single *Eucalyptus*. The lowlands along the coast appear at first sight to be largely covered by *Eucalyptus*, but on closer inspection the tree is seen to be the *niaouli* (*Melaleuca leucodendron*). This tree must have some special facility for distribution, since it occurs not only in Australia, but also so far north as Siam, where (as I learn from Dr. Kerr) it is called *samet*. Without going into further detail, it may be said that it is wholly incredible to a botanist that this flora has acquired its peculiar features since some time in the Oligocene. It is equally incredible that since that time the now peculiar types migrated from somewhere else. Quite significant is the very small number of native grasses and the large number of endemic orchids. There is only one cycad (*Cycas neocaledonica*), which we saw growing by the coast near Bourail.

When we come to the snails, they tell a similar story. The endemism is tremendous, and the fauna has the aspect of great antiquity. The characteristic large edible snails, of the genus *Placostylus*, have very close relatives on Lord Howe Island, and the genus is also represented in New Zealand. The *Placostylus* of Fiji and the New Hebrides are of a different appearance and seem to be generically or subgenerically separable. (Ancey proposed the generic name *Diplomorpha* for a New Hebrides species.) The highly characteristic genus *Platyrhitida* occurs in New Caledonia and Lord Howe Island,[2] but the latter island has some remarkable snails apparently without relatives in New Caledonia. A curious case is that of the endemic *Papuina mageni* (*Bulimulus mageni* Gassier), which I found living on trees at Bourail. As Mr. Iredale pointed out to me, it appears to be nearly related to *P. folicola* Hedley of Queensland, found on leaves. It is, however, quite distinct as a species.

In other groups New Caledonia shows similar evidences of a very ancient fauna. There is the extraordinary and unique bird, *Rhinochetus jubatus* Verr. and Des Murs, forming a very distinct family. There are 18 endemic species of the earth-worm genus *Acanthodrilus*. The leeches include a special genus. The diplopods or millipedes, always a good index of past conditions, present an astonishing array of endemic forms—including five peculiar genera, one of which cannot be readily placed in the system. The terrestrial Isopoda include 44 species, all endemic except two introduced cosmopolitan forms. There are numerous endemic land planarians.

On the other hand, if we postulate continental connexions in late Tertiary times, it is impossible to explain the total absence of numerous groups of animals and plants which are common in the regions which might conceivably have been thus connected.

Having written the above, I tried to develop a new argument on the other side of the question, and the following, based on the ants, appears to be worth offering. The ants of Baltic amber (Oligocene) are very well known, and have been rather recently (1914) revised by Wheeler. There are 43 genera, of which 19 (44·1 per cent) are extinct. All the species are considered to be extinct, but some are almost identical with living forms. Five of the extinct genera are so peculiar that Wheeler classifies them as of uncertain affinities. Now, supposing New Caledonia to have received its fauna during the Oligocene, and nothing since, the present ant fauna of that island might be expected to be quite as peculiar as that of the amber,

and even more so, owing to the evolution on the island since the Oligocene.

The ants of New Caledonia (77 species and varieties) were listed by Wheeler in 1927. I collected what ants I could, and sent them to Mr. John Clark of the Melbourne Museum. I have not been able to get any information from Mr. Clark, but a mutual friend wrote me that he examined them and found no new species. Thus it is probable that the ant fauna is fairly well known. The commonest, or at least most conspicuous species, is *Polyrhachis guerini* Roger. It must be said of these ants that, compared with those of the amber, they are a very ordinary lot, and show little evidence of the antiquity which we infer from the plants and molluscs. Taking the ants alone, we should suppose them to have arrived (not counting those introduced by man) no earlier than the Pliocene. There are only two endemic genera (and one subgenus), but 64 per cent of the species or races are endemic.

Certainly, if New Caledonia had received its fauna during the Oligocene, and nothing since, we should expect to find 100 per cent of endemism as regards species; and as for genera, there is much truth in Mann's remark (1919) that "the Melanesian subregion (including Vanikoro, the New Hebrides, New Caledonia, and Fiji), like the Chilean and Malagasy, might be described as a biological conservatory, where types once tropicopolitan have been isolated and preserved, free from invasion". Yet the last sentence is too extreme, for there evidently has been invasion during late Tertiary time, but apparently of the accidental type which is characteristic of islands. Neither the Australian nor the Malayan biota has come over as it must have done with complete land connexion. We may infer that many of the peculiar generic types of New Caledonia had their origin on the land mass of which it is a fragment, but this cannot, in any particular case, be actually proved.

T. D. A. COCKERELL.

University of Colorado, Boulder,
Jan. 12.

[1] *Comptes rendus Acad. Sciences*, Paris, vol. 176, p. 1668. See also an account of the spiders of the Loyalty Islands, *Bull. Soc. Ent. France*, vol. 54, p. 387; 1929.

[2] *Platyrhitida balli* (Brazier) on Lord Howe Island. I am indebted to Mr. Iredale for a specimen.

The Meaning of Existence.

I DO not know whether anyone has directed attention to the striking agreement of the conclusion of "The Mysterious Universe" with the final form in which Kant expressed his conclusion concerning the nature of the objective world in the "Critique of Judgment". My particular reference is to Remarks 1 and 2 appended to the 57th Section. In this passage Kant makes the distinction between the *Æsthetic Idea* and the *Rational Idea*, and it marks the transition from the consideration of the æsthetic judgment of taste to that of the teleological judgment of purpose in Nature. But the real significance of the passage is seen to lie in Kant's complete grasp of the relation between the intuitive knowledge of the world in sense perception and the objective knowledge of the world in scientific reasoning. It is this which makes Kant's theory so relevant to the modern scientific interpretation of physical reality.

I do not claim for Kant any premonition of Sir James Jeans's conception of God as the great mathematician. Such a concept of God follows from a view of the nature of scientific truth impossible in Kant's generation. What I have in mind is the forcible bringing home of the fact that the real world of science resembles a thought rather than a thing. Kant expressed it in terms of purposiveness. In the æsthetic judgment of taste, the imagination judges the beautiful in accordance with the principle of a purely subjective purposiveness; in the teleological judgment, the understanding objectifies purpose in Nature. In other words, Nature is objective thought.

It is this final outcome of Kant's theory which brings his philosophical problem into line with the modern scientific problem. It starts with the autonomous world of sense perception, which, as Berkeley proved in a simple argument which has never been undermined, is entirely subjective. Our perceptions exist nowhere but in our mind. The objectivity of the world is a logical inference, and the form it assumes is a construction of thought. Is it strange, then, that when we study this world scientifically we find it resembles a thought rather than a thing? What we find difficult to understand is that in discovering this we are not discovering the world to be illusion, but positively real. When we say the world is thought, we mean that mind is original existence; that perceiving, thinking, reasoning are the expression of its activity; and that thought is the fixed form of its objectivity. This certainly was the meaning of Kant, however halting his earlier attempts to express it. It is, if I mistake not, Sir James Jeans's meaning, and certainly it is mine.

H. WILDON CARR.

University of Southern California,
School of Philosophy,
Los Angeles,
Feb. 5.

Morphology of the Pharynx of Female *Culicoides* and its Taxonomic Importance.

WHILE studying the structure of the pharynx and buccal cavity of some female *Culicoides* in an attempt to correlate their affinities, if any, with the taxonomy of the group, it was found that the structure varies considerably in both the local and exotic forms. In the case of *Culicoides pulicaris*, a European species, it is found that the pharyngeal armature is distinctly of *Phlebotomus* type,[1] inasmuch as it not only bears distinct serrations posteriorly, but also is furnished along one of its walls with a thin, rather deeply chitinised, pigmented ridge, which in its turn carries a series of backwardly directed teeth (Fig. 1, *a*). The two local Indian species, namely, *Culicoides oxystoma*, Kieff., and *C. peregrinus*, Kieff., on the other hand, have pharyngeal armatures which apparently bear very little similarity with its related exotic form. The pharyngeal armature of these two forms is horseshoe shaped (Fig. 1, *b*), that is, the two arms are free at the proximal end, and they appear to be undivided at its distal region, leaving a very thin lumen in between, which communicates posteriorly with the alimentary canal. The two free ends simulate the open ends of the shells of a bivalve mollusc, and each bears a few filamentous, outwardly directed processes. The lateral fringes of the pharynx bear inwardly very fine serrations. The differences between the structures of the pharyngial armature of the two Indian species are as follows: In the case of *C. oxystoma* the lateral edges of the armature are somewhat more overlapping in the middle, and the lateral serrations are less distinct than those of *C. peregrinus*.

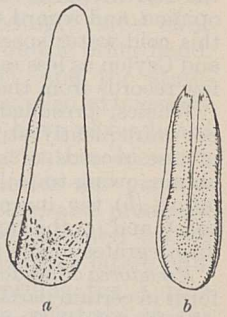

FIG. 1. ×200.

I have also traced two sets of muscles on each side of the dorso-lateral walls of the pharynx which apparently aid in the creation of vacuum, thus causing an inrush of blood through the fine channel of the pharynx.

Whether the structure of the pharyngeal armature will play an important rôle in the classification of female *Culicoides* depends considerably on observations on a larger scale; meanwhile, a preliminary observation of this nature, to elicit further observations on the subject, would not be out of place. A detailed and more confirmatory result in this direction will be published elsewhere as specimens of both local and exotic types are forthcoming.

S. MUKERJI
(Entomologist under the Indian Research Fund Association).
Kala-azar Research Laboratory,
School of Tropical Medicine and Hygiene,
Calcutta, Jan. 3.

[1] Adler, S., and Theodor, O., *Bull. Ent. Res.*, **16**, pp. 399-405; 1925–1926.

The False Killer Dolphin.

WITH regard to the occurrence of *Pseudorca crassidens* in Ceylon, to which reference was made in NATURE of Dec. 6, 1930, p. 892, and Jan. 10, 1931, p. 60, the full circumstances were not recorded at the time, owing to a printer's lapse. An account of the stranding of a school of 167 false killer dolphins off the northern coast of Ceylon is now in the press and will be published in the *Ceylon Journal of Science* (Sec. B). This species was previously recorded from Ceylon about forty years ago.

The distribution of this species presents points of exceptional interest. Apart from the few records from the north-west European coast, the known distribution of *Pseudorca crassidens* is not inconsistent with the view that it is a sub-antarctic oceanic form which occasionally wanders northwards in large schools into the Pacific, Atlantic, and Indian Oceans. Is it not possible to regard the occurrence of this species in the North Sea as fortuitous? I am inclined to this opinion, and regard the three recorded appearances of this cold-water species off the coasts of South India and Ceylon as less remarkable than the comparatively few records from the North Sea.

Whales, presumably from the southern seas, are not infrequently stranded on the Ceylon coast, but precise records of such occurrences are difficult to obtain, owing to (*a*) the ignorance of the fishing population, (*b*) the inaccessibility of a large part of the coast, and (*c*) the rapidity with which a whale carcase disintegrates in the tropics.

Pseudorca crassidens has been described as a common form in certain parts of the southern seas, and I agree with Sir Sidney Harmer that there is little justification for the statement that this species is on the verge of extinction.

JOSEPH PEARSON.
Colombo Museum,
Feb. 4.

An Unusual Ice Formation.

ON the morning of Saturday, Jan. 31, after a frosty night, we discovered in the bird-bath on the lawn a remarkable ice structure. The bath is a circular metal basin, 10 in. in diameter at the rim, with a concave base admitting of a maximum depth of 2 in. of water in the centre. There was a solid mass of ice of not less than 1 in. and not more than 1¼ in. maximum thickness, with a level (though not smooth) surface 8 in. in diameter. From the centre of this rose a pillar of ice, in the form of a triangular prism, 2¼ in. high, tapering slightly downwards and flat-topped. The plan was a nearly right-angled (very slightly obtuse-angled) triangle, the two shorter sides measuring 1¼ in. and ¾ in. respectively; the hypotenuse was slightly curved and irregular, not convenient for measurement. When warm water was poured into the bath, the ice melted in contact with the sides, and the whole could easily be lifted out in one mass, the pillar being used as a handle. Certain appearances suggested that the pillar might be hollow, but I did not break it across, so that must remain doubtful. The combined block of ice was placed in a shaded place and, though melting slowly, retained its strange appearance through the whole of the day.

I am indebted to a number of my colleagues, and particularly to Prof. A. O. Rankine and Dr. H. T. Ellingham, for a very interesting discussion of this phenomenon. The most feasible explanation appears to be that freezing began, as usual, at the margin of the surface of the water, and ice crystals grew inward until the surface was completely frozen except for a triangular area in the centre. At this stage there was a rapid fall of temperature and the water below the surface began to freeze quickly. The expansion accompanying solidification caused the excess of volume to be forced through the triangular aperture, the water freezing as it rose.

A. MORLEY DAVIES.
Arngrove, Amersham, Bucks,
Feb. 10.

Wisdom in Words.

THE caption and the questions of "Inquirer" (NATURE, Jan. 31, p. 166) are salutary. Is he, perchance, a reincarnation of Francis Bacon, who warned future experimentalists of the dangers of idols of the mind created by the speculative Schoolmen?

The modern etymology of the word 'philosophy' has not been accepted by all scholars, including M. Ragon, the French authority, of the last century, on the Egyptian mysteries. He contended that ancient philosophers were scientific workers, and that their philosophy was a real science—not simply verbiage; that 'philos' does not represent here a noun, or mean 'affection': it is the term used for Eros, synonymous with πόθος, the universal, creative energy of Nature—the abstract 'desire' or procreative activity inherent in Nature. Hence *philosophia* originally signified knowledge of the energies within objective phenomena; and *philosopher*, one who had assimilated in himself, or personified as it were, creative knowledge or the 'wisdom of creation', and could, therefore, experimentally demonstrate it. The tradition may be true, then, that Pythagoras modestly refused to be called a philosopher!

W. W. L.

William Hyde Wollaston.

I AM collecting materials for a biography of William Hyde Wollaston (1765–1828), and would be most grateful for any documents or other information bearing on him which readers of NATURE could supply. All documents would be carefully handled, and would be returned to the senders as soon as copied.

L. F. GILBERT.
Department of Chemistry,
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Feb. 6.

The Audibility and Lowermost Altitude of the Aurora Polaris.

By Prof. S. CHAPMAN, F.R.S.

THE aurora polaris, after long study, remains in many respects mysterious; of late years, however, scientific opinion has been nearly unanimous in regard to its height in the atmosphere, locating it at about 100 kilometres and above. Størmer has found trustworthy evidence, in a few cases, of its occurrence so low as 80 km. Its upward extent is very variable, but at times it rises to a height of 800 km. These very high auroræ seem to occur exclusively in the part of the atmosphere which, though viewed from stations in the night hemisphere, is itself still illuminated by the sun's rays; no very likely explanation of this remarkable fact has yet been proposed.

The gradual accumulation of trustworthy photographic measures of the height of auroræ, observed simultaneously from two or more stations, since Størmer introduced his now well-known methods, has steadily added strength to this conviction. Yet from early times to the present day there have been occasional reports of auroræ situated at much lower heights, so as to be visible between the beholder and high land at no great distance. Likewise there have been many accounts of auroræ having been *heard*, a thing scarcely to be credited if they are located at heights of 80 km. or more. Both kinds of observation have in general been viewed with suspicion.

In 1918, Dr. G. C. Simpson, in a letter to NATURE (Sept. 12; p. 24), referred to the question of low auroræ, and recounted three cases that came under his notice during the 1910–12 Scott antarctic expedition: he had asked his colleagues to direct his attention to any auroræ observed by them at low altitudes; in each instance he concluded, on personally viewing the aurora, that its situation below the clouds, or between the camp and neighbouring mountains, was only apparent—that chance circumstances combined to produce an optical illusion, distinguishable as such only on the closest scrutiny. Indeed, on one of the three occasions a majority of his colleagues were not convinced by him that the appearance was only illusory.

Such an examination, by a first-rate observer, of observations that were apparently anomalous, and contradictory of the results uniformly given by the best methods of observation, was of great value. Since it dealt only with a few particular cases, it could not dispose of the possibility that in other cases the appearance of low auroræ was real and not counterfeit; yet it certainly showed that now and then appearances were very likely to deceive, and emphasised the need for caution in accepting reports even from the most trustworthy and convinced observers.

The discussion has recently been carried to a further stage through the zeal of Mr. J. Halvor Johnson, of San Mateo, California, who for many years lived near, and beyond, the Arctic circle, and witnessed many auroræ. During these years he observed, once only, in Alaska, in 1901, an unmistakably low aurora, which was visible between himself and a mountain about half a mile distant, rising to about 1200 feet above his own level. Moreover, on this and but one other occasion he heard sounds accompanying the aurora. At the time he had read little with reference to the aurora, and was ignorant of the prevailing opinion that the aurora is confined to the upper atmosphere. In recent years his conviction, based on his own experience, that this opinion is not true in all cases, has led him to seek further evidence on the point, from other observers. From few parts of the world is such information likely to be more readily available than from North America—Alaska and northern Canada. Here, owing to the inclination of the earth's magnetic axis in this direction, a long stretch of the zone of maximum auroral frequency passes overland, in a region which, though inhospitable and sparsely populated, is yet inhabited by a large number (in the aggregate) of civilised men, including some, such as surveyors, and occasional professional men in small townships, of considerable intelligence and education. Mr. Johnson, recognising that low-level auroræ are at least rare, and apparently have not occurred at times and places where arrangements for measuring their altitude were available, in 1928 addressed a letter to each of the newspapers published in Alaska and the British Yukon Territory, seeking information in regard to auroral displays.

In this letter Mr. Johnson directed particular attention to the question of low altitude and sound, stating the position very fairly: "much respectable testimony", on one hand, in favour of occasional sounds, and "exceedingly rare" close approaches of the aurora; and, on the other hand, the prevailing scientific disbelief, and the statements of many men who have travelled extensively in the arctic regions, that they have never heard auroral sounds. He did not mention his own experience or conviction. His letter was given a prominent place in the newspapers, and produced many replies; some of these he followed up by further direct correspondence. He has lately published a small pamphlet "Concerning the Aurora Borealis" (29 pages; privately printed, at the Gazette Press, Berkeley, California, 1930), giving a selection of the letters (17 pages), accompanied by an introduction and brief historical account of the subject (11 pages). The writers of the letters include men from various stations in life, from "the simple pioneer and prospector, whose spirit of helpfulness outweighed his diffidence in writing, to the professional man of disciplined observational training".

This inquiry is in some respects similar to one made by Sophus Tromholt in Norway in 1885: Tromholt wrote in NATURE (Sept. 24, 1885, vol. 32, p. 499) that up-to-date, out of 103 replies bearing on the question of auroral *sounds*, 53 were from

writers who had personally heard such sounds, while a further 39 cited the testimony of others to the same effect; the remaining 21 declared they had never heard the sounds, or knew nothing of them. It may be recalled also that in NATURE, Jan. 8, 1927, vol. 119, p. 45, Prof. Størmer reported that on Oct. 15, 1926, H. S. Jelstrup and an assistant, at the observatory near Oslo, both heard auroral sounds during ten minutes which they were able to spend in the open watching the aurora, before continuing their observations; the sound was a very curious faint whistle, increasing and decreasing, seeming to follow exactly the vibrations of the aurora. Unfortunately, Størmer had no successful photographs of the aurora during the period in question.

Mr. Johnson's pamphlet contains letters from twenty persons. One of them does not refer to the two points here under discussion. Seventeen testify to having heard sounds accompanying auroræ, and some cite one or more friends who can bear similar testimony; sixteen state that they have seen auroræ coming close to the ground, and, of these, twelve assert that they have seen the light against a background of mountains or other objects near the ground. All these letters appear to be written in perfect good faith. Several of the writers who have heard auroral sounds describe them as fairly frequent; others have heard them only on one or a very few occasions in many years.

The sounds are variously described as "a swishing or rustle, like that of a silken skirt moving back and forth, . . . very low, but yet plainly discernible"; like those "that accompany small static discharges"; like the sound made when "a couple of slices of good fat bacon are dropped into a red-hot pan"; "they may attain a loudness comparable to that emitted by a high-tension electric current when charging a set of horn-gap lightning arresters"; "quite audible swishing, crackling, rustling sounds"; "a crackling so fine that it resembled a hiss"; sounds "similar to escaping steam, or air escaping from a tire"; "much like the swinging of an air hose with escaping air"; "the noise of swishing similar to a lash of a whip being drawn through the air"; sounds "likened to a flock of birds flying close to one's head"; "not musical, it was a distinct tearing, ripping sound as when thin muslin is ripped or torn apart". One man at sea, in an open boat with four natives, on Oct. 11, 1893, heard "the most fearful whizzling and crackling sounds, sounding at times as if thousands of firearms were fired within short distance"; at the time there was "no wind and no clouds". Another writer mentions "loud reports similar to rifle cracks", "the air was still and the aurora was just above the tops of the birches"; the few loud reports were followed by much crackling.

Some of the accounts of low auroræ seen between the observer and terrestrial objects are very striking and circumstantial. One writer states that he and his party (members of a government radio station, in the winter of 1917–18) were enveloped in "a light mist or fog-like substance in the aurora"; a hand extended could be seen as if in a coloured fog, and a kaleidoscope of colours was visible between the hand and the body. It was impossible to feel this visible fog or mist, and there was no dampness. By stooping close to the ground it was possible to see under this light, which did not go below four feet from the ground. The low-hung aurora lasted fifteen minutes, while great streaks and shafts of light came and went in the heavens. The occasion was unique in the writer's experience.

Another writer, during a brilliant auroral display, saw the light "play" down between himself and a steep glacial deposit bank about 125 feet away; he "stepped right into the aurora". Another saw an aurora between himself and a ten-foot bank not more than one half-mile away; there was "immense light", "on the very surface", and a shaft of light shot up to an immense height. Another in 1915 saw the familiar landscape "beautified by changing coloured lights which came and went rapidly, now bathing us, now withdrawing with a swish to a height of a mile or so"; "it came down in streamers, or again as a fog (only much faster than fogs come, only a matter of seconds)"; "we saw the tree trunks through the aurora", the colours being mostly, though not wholly, greens.

These letters make it difficult to deny that auroræ occur, very rarely, quite near the earth, and are sometimes accompanied by noises. Almost all the reports come from a belt of country about three hundred miles wide, lying roughly along the auroral zone; the belt includes the Klondike region, where is situated the township of Dawson, with a population of several thousand; several reports come from this neighbourhood. The only other places along the auroral zone, likely to afford such favourable fields of inquiry, appear to be near Churchill, on Hudson Bay; the extreme south of Greenland; Iceland and the most northerly part of Norway.

Since very low auroræ seem to be very rare and to be confined to localities near the auroral zone, it is perhaps not surprising that Størmer, Vegard, and Krogness should have observed no such case, or that the Polar Year (1882–83) failed to provide evidence establishing their existence; with the better organisation of auroral observation which it is hoped to achieve during the proposed new Polar Year (1932–33), there is more chance that opportunities of critical examination of these appearances will occur.

These low auroræ must obviously be very different in character from those observed in the upper atmosphere, though connected with them. Inability to understand their physical nature is not a sufficient ground, in the present state of knowledge, for rejecting the possibility of such occurrences; such an attitude would, for example, forbid acceptance of the reality of globular lightning. The observations cited by Mr. Johnson constitute at least a case for active further inquiry, and render it highly desirable that auroral investigation near the auroral zone should include not only visual and photographic observations, but also atmospheric electric registration at a well-equipped observatory.

Science Medals of Great Britain, Ireland, and the Dominions.

AS a supplement to the issue of NATURE of Nov. 15, 1930, we published an article on medals awarded for scientific achievement, and brief classified statements relating to the various medals in the gift of institutions of the British Empire. The difficulty of making the list exhaustive was obvious, and we print below particulars of further awards to which our attention has been directed.

I. GENERAL.

Royal Society of Western Australia, Perth.

Society's Gold Medal.—Arising from the commemoration of the centenary of birth of Lord Kelvin, in 1924, the Society decided to institute a gold medal for award from time to time for distinguished work in science connected with Western Australia. The entire initial cost was borne by voluntary subscriptions. The award is made on a recommendation by a medal committee of five members, and normally at four-yearly intervals. The first allotment was in 1925, to Dr. W. J. Hancock, for pioneer research in radiology; that for 1929 was given Dr. E. S. Simpson, government mineralogist and analyst. The obverse of the medal bears the bust of Lord Kelvin.

Royal Numismatic Society of London.

Society's Medal.—Founded in 1883, and awarded annually or otherwise in silver or bronze for distinguished services to numismatic science; the recipient may be of either sex, and there is no restriction as to nationality. The first allotment was made to Charles Roach Smith, the eminent antiquary; that for 1930 to Mr. P. H. Webb, president of the Society.

British Numismatic Society.

Saltus Gold Medal.—Founded in 1910 by Mr. John Sanford Saltus, of New York, a vice-president. Awarded triennially to "the member of the Society whose paper or papers appearing in the Society's publications shall receive the highest number of votes from the members, as being in their opinion the best in the interests of numismatic science". Allotment was made in 1929 to Mr. J. S. Shirley-Fox.

University of Melbourne.

David Syme Research Medal and Prize.—(Mr. E. O. Hercus, 16 Melbourne Place, Cambridge, directed our attention to the omission of this prize. Strictly, the original series comprised the awards of medals made by scientific academies and societies, but the following account will be of interest.)

Founded by the gift of £3000 by David Syme for the purpose of encouraging in Australia the carrying out of research work in biology, chemistry, geology, and natural philosophy. The award takes the form of the annual bestowal of a gold medal and gift of £125 for a thesis based upon original work in the departments of science mentioned above, but preferably in connexion with the material and industrial development of Australia. The thesis must either have been published not more than two years before an allotment, or published afterwards in such a manner as shall satisfy the council. The prize is open to any person who has been resident in Australia for not less than five years out of the seven years immediately preceding that in which the prize is offered. No professor in an Australian university and no head of a scientific department under any Australian authority is eligible.

II. PHYSICAL AND MATHEMATICAL SCIENCES.

Institute of Actuaries.

Institute Gold Medal.—In 1920 it was decided to establish a gold medal in recognition of any paper or treatise of outstanding originality in actuarial science, the award not to be restricted as to nationality or sex.

N.B.—No award of this medal has been made so far, but it should be mentioned that in 1927 and in 1929 special gold medals were struck, and bestowed respectively upon two distinguished exponents of actuarial science.

British Astronomical Association.

Walter Goodacre Gold Medal.—Founded in 1929 through a fund provided by Mr. Walter Goodacre, a past president, and for award to members in recognition of contributions to the progress of astronomy, special regard being paid to work communicated to the Association. An award is made at intervals of not less than two years nor more than four years. The first allotment was made in 1930 to the Rev. T. E. R. Phillips.

Institution of Civil Engineers of Ireland.

Mullins Medal.—The Institution awards medals (or premiums) annually under the terms of a bequest by Mr. M. B. Mullins, president in 1859–61. The medals may be of gold or silver, and refer in bestowal to meritorious papers read before the Institution. The obverse of the medal bears the head of Mullins.

Institute of Fuel.

Melchett Medal.—Inaugurated in 1930 by Lord Melchett, founder-president (1927) of the Institute, to mark the completion of his period of office, for annual award. It is struck in bronze, and awarded to such person, whether a member of the Institute of Fuel or otherwise, as in the opinion of the council has done either original research or professional, administrative, or constructive work of an outstanding character involving the scientific preparation or use of fuel, provided the results of such work have been made available within recent date for the benefit of the community. The allotment is without restriction as to the nationality of the recipient. The first award was made to Dr. Kurt Rummell, principal of the Wärmestelle, Düsseldorf. It is the intention of the council to invite the recipient each year to give a Melchett lecture, following the presentation of the medal.

Society of Glass Technology, Sheffield.

Frank Wood Medal.—In 1919, the Society, in order to commemorate the services of Mr. Frank Wood, who was the first president, to the glass industry and glass technology, inaugurated a fund and decided to found a medal in bronze; the award to be placed in the gift of the University of Sheffield, and allotted annually to students in the Glass Technology Department. The University holds the fund as trustee. The design of the medal was entrusted to Mr. P. Metcalfe, Royal College of Art, South Kensington.

British Horological Institute.

Institute's Gold Medal.—The Institute was established in 1858. In 1928 a gold medal was founded for annual award, at the discretion of the council, for the greatest advance in the science of horology, or some achievement of outstanding merit beneficial to the science or practice of time measurement. The first recipient was the Astronomer Royal, Sir Frank Dyson. The reverse of the medal carries the inscription: "For having improved horology by practice and enriched it with learning".

British Institute of Radiology.

Silvanus Thompson Medal.—Founded in 1918, in association with a memorial lecture, and in commemoration of Prof. Silvanus P. Thompson, F.R.S., the first president of the Röntgen Society. Distinguished workers in radiology or allied subjects, of any nationality, may be invited to deliver the lecture, and, so far as possible, choice falls alternately on a medical and a non-medical man. The medal is struck in bronze and bears the bust of Thompson. An honorarium is attached to the lectureship.

Mackenzie Davidson Medal.—Founded in 1920, in association with a memorial lecture, and in commemoration of Sir James Mackenzie Davidson, a pioneer in British radiology. Distinguished workers in radiology or allied subjects, of any nationality, may be invited to deliver the lecture, and, so far as possible, choice falls alternately on a medical and a non-medical man. The medal is struck in bronze, and bears the bust of Mackenzie Davidson. The regulations provide that the choice of lecturer shall be made each year by a joint selection committee appointed by the Institute and the Electro-Therapeutic Section of the Royal Society of Medicine. An honorarium is attached to the lectureship.

Society of Radiographers, London.

Reid Medal.—Instituted as a memorial of the services of Sir Archibald Reid. Struck in silver, it is awarded annually in competition amongst members of the Society for radiographic films of merit, applicable to selected subjects which are chosen by the council. The obverse of the medal bears the bust of Reid.

Australian Chemical Institute, Sydney.

Smith Memorial Medal.—Founded in 1929 to perpetuate the memory of Henry George Smith, one of the foundation officers of the Institute and a pioneer in research into the chemistry of the Australian eucalypts. The leading Australian scientific societies were represented on the memorial committee, and contributions to the fund were received from each State in the Commonwealth. It is struck in bronze, and awarded annually to that person who has, in the opinion of council, contributed meritorious service to the development of chemical science. The first allotment (1929) was made to Dr. A. C. D. Rivett, of Melbourne, for research work published during the ten preceding years.

Rennie Memorial Medal.—In the course of 1930, members of the Institute established a fund to found a bronze medal in memory of Dr. Rennie, Angas professor of chemistry in the University of Adelaide for more than forty years. He was actively associated with the formation of the Institute, and at one period was its president. It is proposed to award the medal annually, among the younger members of the Institute, for research work.

III. Biological Sciences (including Geology and Geography).

Royal Society of Tropical Medicine and Hygiene.

Chalmers Memorial Gold Medal.—Founded in 1921 by Mrs. Chalmers, widow of Dr. Albert John Chalmers, author of numerous works on tropical medicine and hygiene, and student of the hygiene of the tropics. The award is made biennially, and bestowal is in recognition of research of outstanding merit contributing to the sciences of tropical medicine or tropical hygiene. There are no restrictions as regards nationality, sex, or profession. The medal bears on the obverse the head of Dr. Chalmers; on the reverse a representation of *Anopheles costalis*, and below, a spray of the cinchona plant. The first award was made in 1923 to M. Roubaud, Pasteur Institute, Paris.

Manson Medal.—A fund had been subscribed in 1921 by friends and admirers of Sir Patrick Manson, in all parts of the world, with the view of obtaining a memorial portrait. A balance in the fund being available, a bronze medal was founded in memory of Manson's fruitful work and influence in the field of tropical medicine and hygiene. The capital sum, with the allotment of the medal, was vested in the council of the Royal Society of Tropical Medicine and Hygiene. An award is made triennially to the living author of such original work in any branch of tropical medicine or tropical hygiene as may appear to be deserving of the honour. There is no restriction as to the age, sex, profession, or nationality of the author. The obverse of the medal bears the bust of Manson. The first recipient was Sir David Bruce; the last (1929), Sir Ronald Ross.

Royal Army Medical and Allied Services.

North Persian Forces Memorial Medal.—In 1921 a fund was raised by certain officers of the Royal Army Medical Corps and Indian Medical Service who took part in the withdrawal of the North

Persian Forces and their subsequent dissolution. Struck in silver, a medal is awarded annually for the best paper on tropical medicine or hygiene published in any journal during the preceding twelve months by a medical officer, of less than twelve years' service, of the Royal Navy, Royal Army Medical Corps, Royal Air Force, Indian Medical Service, or of the Colonial Medical Service. A Memorial Committee determines the attainment of a standard of merit. The first award was made in 1923. The recipient for 1929 was Capt. H. W. Mulligan, Indian Medical Service.

Obituary.

DR. ALFRED P. MAUDSLAY.

ALFRED PERCIVAL MAUDSLAY passed away peacefully in his sleep on Jan. 22, in his eighty-first year, at Morney Cross, near Hereford. Born on Mar. 18, 1850, at Lower Norwood Lodge, he attended first a boarding school at Tunbridge Wells and then went to Harrow. He was keen in all forms of sport, particularly fishing, and shot for his school in the winning team for the Ashburton Shield. Leaving school, he proceeded to Trinity Hall, Cambridge, of which he was made an honorary fellow in 1923. A visit to the West Indies was made in 1872, and from Panama and Guatemala he went north to San Francisco, on his way to New York, and there met his future wife, a daughter of Governor Morris of Old Morrisania, New York. The following year, accompanied by his brother, he visited Iceland, making the ardous trip round the island, but he also tells of many pleasant days fly-fishing.

After taking his degree in 1875, Maudslay went to Trinidad, where he accepted his first appointment as private secretary to H.E. the Governor. He next acted in a similar capacity to the Governor of Queensland. Joining the staff of Sir Arthur Gordon as private secretary, he went to Fiji, becoming in turn Acting Colonial Secretary to Fiji, Deputy Commissioner to Tonga and Samoa, and Acting Consul-General for the Western Pacific. In 1876 he accompanied Lady Gordon to New Zealand, where he spent some months, crossing into the then prohibited Maori Territory. Returning to Fiji, he went to live on Tonga as Deputy Commissioner. He left these Pacific islands in 1879, but it was only last year that he published a delightful autobiography of that period in "Life in the Pacific Fifty Years Ago".

Maudslay in his visit to Guatemala was so struck with the Maya ruins he had seen there that he decided to give up his diplomatic career and devote his life to exploration in Central America. To that country and Mexico he made at least seven expeditions, visiting, clearing, measuring, photographing, and plotting all the then known Mayan ruins, and the results of these expeditions appeared in 1889 in the "Biologia Centrali-Americana . . . Archæology". By this monumental work he laid the foundation of Maya research, which has since been enthusiastically taken up by German and American scholars. This, unfortunately, cannot be said of Great Britain; his priceless collection of 'squeezes' and moulds (which had cost him £10,000) he presented to the nation; but they lay neglected, falling to pieces and eaten by rats, for upwards of thirty-five years in the vaults of the South Kensington Museum, until they were rescued in 1923 by Capt. Joyce on behalf of the British Museum. There they were pieced together and restored, and casts made and set up in a room to themselves, as they deserve, and now form the finest collection of Maya casts in the world. There is an interesting and well illustrated account of these casts compiled by Dr. Maudslay and Capt. Joyce. Maya expeditions to British Honduras, under the direction of the British Museum, have gone out annually since 1926, but the lack of public interest has made expenditure a first consideration, and were it not for the generous help of a few private individuals who supplement the small British Museum grant, it is doubtful if many more expeditions can go out without the help of the United States.

When Maudslay made his seventh expedition to Central America, he was accompanied by his wife, and the result was the joint publication of "A Glimpse at Guatemala" in 1899. This charming and beautiful book is printed on hand-made paper and profusely illustrated with photogravures, coloured plates, and chromo-lithographs. The next work from his pen was a translation, with introduction and notes, of Bernal Diaz' "The True History of the Conquest of New Spain" for the Hakluyt Society, and it ranks among the finest of that Society's publications.

In the summer of 1912, the eighteenth International Congress of Americanists met in London under the auspices of the Royal Anthropological Institute, when Maudslay was president; and when the Congress visited Oxford the honorary degree of D.Sc. was conferred on him for his contributions to Mexican and Mayan archæology. Cambridge also honoured him by conferring on him the honorary degree of Sc.D.

In 1915 Maudslay was one of the joint secretaries of the Royal Geographical Society, in which he took a keen interest, specially at the time when the Society moved from its cramped quarters in Savile Row to Lowther Lodge. In 1928 Maudslay published a popular edition of "The Discovery and Conquest of Mexico", with introduction and notes.

It was in 1905, in Mexico City, that the present writer had the pleasure of first meeting Dr. Maudslay, at a luncheon at the British Legation, sitting next to him; the conversation naturally turned on archæology, and, mentioning having visited the ruined cities of Ceylon, he said it was just 'a toss up' whether he had gone to Ceylon or Central America to excavate. Immediately after luncheon

we went to the National Museum; he was very proud of his post as honorary professor of archæology there, and pointed out Maya sculptures which were wrongly labelled as Zapotec. A few years later, after visiting the ruins of Palenque with the Mexican Government expedition, and remarking that it took us three days to reach them from Frontera at the mouth of the Usamacinta River, he smiled and said it had taken him nearly three months!

Throughout all his Central American travels, Maudslay seems to have been endowed with extraordinary patience and perseverance, and this, together with his charm of manner and personality, enabled him to overcome all obstacles, whether of local politics, native prejudice, lack of guides, transport or labour. Maudslay always gained his point and got his way. To the young archæologist he was always ready with help, advice, or encouragement, especially in the study of Maya glyphs, and it is difficult to speak in measured terms of his loss to the Mexican and Mayan student of archæology. Those whose privilege it was to be numbered amongst his personal friends will perhaps best remember him for his kind and gracious disposition, his keen and sparkling eye, and his blameless life. He was the type of the true English gentleman and traveller. We shall not look upon his like again. J. C. C.

MR. DAVID T. JONES, C.B.E., chairman of the Fishery Board for Scotland, who died in Edinburgh on Feb. 4, in his sixty-fifth year, began his official career as a junior clerk in the Fishery Board in 1887. He was promoted after five years' service to be chief clerk, and in 1909 to be secretary to the Board. During the War, he served as Paymaster Lieut.-Commander, R.N.R., prepared a census of fishermen, and organised a fleet of fishing vessels for various patrolling and defensive purposes. His special knowledge of fishermen and fishing interests, extended by this war service, was of great value in his subsequent administrative work. In 1920 he was appointed chairman of the Board. He was especially interested in the fisheries problems of the North Sea, and was one of the British representatives on the International Council for the Investigation of the Sea. His strong support of the Scottish Fishery Board's scientific investigations is evidenced by the expansion of the laboratory facilities for this work under Dr. Alexander Bowman in Aberdeen. Mr. Jones was of cheerful temperament, and was a very genial friend who will be missed in many circles, especially in Edinburgh.

MR. THOMAS HEBDEN, of Keighley, who died on Jan. 3, at the age of eighty-one years, was one of the Yorkshire naturalists who, in the intervals of a business life, devoted himself to a particular branch of botany. He was a correspondent with many of the leading lichenologists of his day, and this correspondence was maintained almost up to the day of his death and is reflected by the numerous references to Hebden in lichenological literature. His correspondence with Nylander added several species of *Verrucaria* to the British flora, these being published under the joint names of Shackleton and Hebden in the *Naturalist* of 1892. His herbarium and scientific books have been bequeathed to the museum of his own town.

WE regret to announce the following deaths:

Dr. Alfred Holt, one of the joint honorary secretaries of the British Association at its meeting in Liverpool in 1923 and founder of the firm of Holt, Thompson and Co., Ltd., manufacturers of fine chemicals, on Feb. 15.

Prof. F. J. Pritchard, plant physiologist of the U.S. Bureau of Plant Industry, who specialised in breeding disease-resisting varieties of tomatoes, on Jan. 13, aged fifty-six years.

News and Views.

THE president of the Russian Academy of Sciences, Dr. A. P. Karpinsky, the distinguished geologist, is leaving his post at the Academy. This decision is the outcome of his unsuccessful protests against the recent forced decision of the Academy to deprive of its membership four academicians, including such historians as S. F. Platonov and E. V. Tarle, whose scientific views have been pronounced by the authorities to be incompatible with their presence in the Academy of a communistic State. It is noteworthy that at the same meeting of the Academy several foreign scientific workers were elected as foreign members. It appears clear, in the circumstances, that the acceptance of membership of the Academy of U.S.S.R. must involve silent agreement with the basic principle underlying the attitude of the Soviet authorities towards science. According to this principle, science is regarded as merely a means to the successful accomplishment of the Five Years' Plan, and scientific workers themselves are forbidden to express, or even to hold, independent scientific views.

NEW ZEALAND has its Scenery Preservation Act, now almost twenty-three years old; and still we wait to see what a British Government Commission will say about the desirability of doing something for British scenery. In New Zealand the Act has worked well, as is shown by the Annual Report for 1930, a blue-book of 30 pages, with many photographs and a map in colour, issued by the Department of Lands and Survey. During the year, proclamations were made setting land apart for scenic or historic reserves to the extent of 6982 acres, and these areas now bring the number of scenic reserves in the Dominion up to 851, with a total area of 511,792 acres. The value of the reserves to the artist and traveller, as well as to the naturalist, is indicated in an appendix by Dr. L. Cockayne and Dr. E. Teichelmann, describing the Glacial Scenic Reserves of Westland. Apart from the annual interest on the capital expended in purchasing the reserves, the accounts show that they are run for about £1276 a year, and this is offset by rents, etc.,

amounting to £757. The annual interest on the invested capital is a more serious drain, amounting to £8979, for with the year's purchases the capital itself stands at just over £200,000.

ANYTHING that will lead to uniformity in the mode of reference to periodicals is to be welcomed; and even more important than uniformity is intelligibility. An "International Code of Abbreviations for Titles of Periodicals", just issued by the International Institute of Intellectual Co-operation ("Physician, heal thyself!"), has both merits. Most wisely it is based on the rules and principles adopted by the compilers of "World List of Scientific Periodicals (1900–1921)", and differs little from them. Those rules were not easily accessible, even though the British Association Committee on Zoological Bibliography reprinted them (Leeds, 1927) and circulated them to zoological periodicals. The present statement, in French and English, is more clearly drawn up, and is obtainable from the Institute for 2·50 fr. Intelligibility must be judged, not by the reader thoroughly familiar with the periodical in question, but by the worker in another branch. Excessive contraction is therefore to be avoided: it should be possible for the educated non-specialist to reconstruct the abbreviated word. Judged thus, some of the contractions proposed seem to "curtail the already curtailed cur". We jib at "Tms" for the *Times*, "Chi" might mean Chile as well as Chicago, and who will guess "L.B." ? Diacritical marks should be avoided for the sake of the printers, and so we approve of "Kbh" instead of the perhaps more intelligible "Kjøb"; but we object to "Ż" for "Żurnal". We could say more, but we prefer to commend this attempt to editors and authors.

CEREBRO-SPINAL or 'spotted' fever has been somewhat prevalent this year, and the outbreak is the subject of a circular recently issued by the Ministry of Health. This disease occurs, to some extent, every year; but in certain years the incidence may be considerably above the average. After the War, when it was prevalent, the number of cases declined to 301 in 1923, since when there has been an upward trend, with 666 cases in 1930 in England and Wales. This year 230 cases among civilians have been notified, about half of which have proved fatal. The cases have been scattered and distributed in 36 counties, with some concentration in the West Riding of Yorkshire. The disease is especially liable to attack children and young persons, and during periods of prevalence the responsible micro-organism (the meningococcus) is to be found in the nose and throat of a number of persons who are and remain well. Such healthy carriers are probably of more importance than the cases themselves in spreading the disease. One factor known to favour local outbreaks is overcrowding in barracks, institutions, and schools. Plenty of space should be provided in dormitories, with thorough ventilation.

UNIVERSITIES in their relationship to national and international movements are discussed in *Bulletin* No. 7, 1930, pp. 43, of the Paris office of the Carnegie Foundation for International Peace. It contains two papers by Prof. d'Irsay, of Johns Hopkins University, and Prof. Bloch, of the Sorbonne, entitled respectively "Histoire Internationale des Universités", and "La Cité Universitaire de Paris". Prof. d'Irsay concludes his historical survey with a generalisation contrasting the spirit in which their teaching work is conducted by universities with that of their scientific research: the former inevitably nationalistic and tending to become monotonous and reactionary; the latter, which is slowly but surely becoming their dominant note, genuinely international and all the more important in virtue of the fact that scientific research is the only real force uniting the world. Prof. Bloch's paper gives an account of the aims, organisation, and present position of the Cité Universitaire, inaugurated in 1924, when buildings providing for the accommodation of 300 French students were begun. Since then hostels have been erected on the Cité estate for Canadian, Belgian, Argentine, Japanese, American, and Indo-Chinese students; and others are in course of construction for British, Swedish, Dutch, Spanish, Armenian, Danish, Greek, Cuban, Monacan, and French provincial students. By 1933 the total number of rooms will be 2500. In order to promote friendly intercourse between the students of different nationalities, a "Maison Commune", for which Mr. J. D. Rockefeller has constituted a foundation of 90 million francs, will provide communal refectories, lounges, music-room, library, gymnasia, etc., and a medical service.

ON Feb. 25, Mr. W. G. W. Mitchell gave a lecture on "Developments in Television" before the Royal Society of Arts. He pointed out that early experimenters in the field of television were handicapped through not having suitable photoelectric cells for converting changes of light and shade into corresponding electrical impulses, and also through the modern valve amplifier then being unknown. But the past five years have shown that a primitive form of television is physically possible. The fundamental difficulties were considered in detail. As examples of the trend of development, Mr. Mitchell dealt with the recent demonstration of two-way television in America, the various attempts made to produce a large screen picture suitable for viewing by large audiences, and the attempts that had been made to overcome purely mechanical methods by using electrical ones. The American Telephone and Telegraph Co., which was responsible for the two-way television system, was primarily seeking information as to the value of the addition of sight to sound in personal conversations over the telephone. The extra apparatus for providing vision is bulky and the operating costs are heavy; but work is in progress to reduce these defects. Speaking of large screens, Mr. Mitchell referred to a recent demonstration by J. L. Baird of an arc lamp the intensity of which was modulated directly by a vision signal. Very good brilliancy was obtained on a screen 7 ft. by 3 ft. at 10 ft. distance by optical projection. Purely electrical methods of television, such as the cathode ray method, will be more widely used as soon as the high voltages required for operating can be reduced. Mr. Mitchell thinks, however, that

the next development will be in the direction of zone methods used in conjunction with wired transmitting circuits. Using these methods, it should be possible within a year or two to have a picture of the size and brilliancy of the cinema screen picture of to-day.

THE presidential address of Dr. W. H. Eccles to the Institute of Physics, delivered last May (see NATURE, June 14, p. 894), has recently been published. He took as his subject the influence of physical research on the development of wireless communication. From the historical point of view the address is of great value, as no one has studied more closely the development of this industry, and in addition no one else has been in personal contact with so many of the pioneers. He points out that in the near future the knowledge, which has been laboriously accumulated, of the effect of atmospheric conditions on radio communication, will be utilised and that further rapid developments will take place. Radio has advanced practically by leaps and bounds. Some of these leaps—for example, the maturing of the triode valve—have led to the scrapping of equipment before it has earned the cost of its engineering development. Industrialists naturally fear these revolutionary improvements, due often to physical research. At present there is much discussion in engineering circles on rationalisation, the main object of which is to reduce the costs of production and eliminate waste in basic industries. Standardisation is a useful help in this direction, and so also is the modernisation of plant and products by the introduction of the latest methods and inventions. The standardisation that asks all manufacturers of certain articles to work to agreed specifications concerns engineers only; but that which calls a halt to the introduction of innovations affects physicists also. This latter form of standardisation is in conflict with the principle of modernisation. Physicists are often looked on askance by engineers, as their revolutionary ideas necessitate changes in manufacture. As, however, they live in the laboratories whence spring the discoveries which may overturn the established order, they are admirably qualified to forecast probable developments, which will enable engineers to decide when to standardise and when to modernise.

THE January number of the *Brown Boveri Review* gives an interesting record of the progress that is being made abroad in the design of electrical machinery. It shows clearly that in electrical traction the advances being made are in the direction of single-phase and direct current working. The Simplon Tunnel, for example, has been operated for nearly twenty-four years by means of three-phase current. Since 1920 it has been operated by seven locomotives, which handled without difficulty the greatly increased passenger and goods traffic after the War. At the beginning of last year, three-phase operation was replaced by single-phase operation, the double type of current collector employed eliminating many difficulties. Devices are now employed which enable the locomotives to run at four economical speeds. The Italian State Railways are electrifying a number of their sections with high-pressure direct current at 3000 volts. The electric power is conveyed to the substations at 60,000 volts three-phase, and is then converted into direct current power at 3000 volts by 2000-kilowatt mercury arc rectifiers. The design of these rectifiers is being continually improved and their size is rapidly increasing. The latest design is a high-power rectifier with eighteen anodes capable of supplying a direct current of 12,500 amperes. Successful investigations as to the possibility of reversing the action of these rectifiers have been made. It is now possible to supply electrical energy from a direct current network to a three-phase network. The frequency of the supply is the same as that of the three-phase generators, or it can be adjusted to any desired value from the direct current side. It can be used for transferring energy from an alternating current system working at one frequency, to another working at a different frequency.

THERE seems to be a need for standardising the airway beacons that are used for guiding aeroplanes at night. In a paper in the *Illuminating Engineer* for February, H. N. Green states the requirements that a good beacon has to fulfil, and draws instructive curves to illustrate the light distribution from beacons of various candle powers. A beacon has to indicate, either by flashing, or by its colour, or by subsidiary lights, its locality on the route on which it lies. When flying at night over inhabited country at a height of 3000 feet, with average visibility a large number of lights can be seen. These lights can be divided into two groups. Local lights such as street lamps and shop windows form the first group. They cease to be visible at a range of from five to six miles. The second class contains the high-powered headlights on motor transport. These sometimes give beams of 50,000 candle power, which are visible at distances up to twenty miles. The presence of these flashes occasionally makes it difficult to identify a white flashing beacon when it is more than five and less than twenty miles away. The true horizon is about seventy miles distant, and if the beacon lies between twenty and seventy miles away it appears as an isolated flashing light and is easily identified. It is suggested that the lower limit for the intensity of a beacon should be 100,000 'beam' candles. The author discusses how the visibility varies with the height of the aeroplane and with the state of the atmosphere. He makes a calculation to show the worst visibility at which flying is possible. Pilots often complain that present-day beacons are conspicuous in clear weather, when they are not much wanted, and disappear in bad weather, when they would be of the greatest help.

AMONG recent donations received by the Zoological Department of the British Museum (Natural History) is a large album containing photographs taken in the Birunga mountain district to the north-east of Lake Kivu, East Central Africa, and dealing with the home of the eastern gorilla (*Gorilla gorilla beringeri*). These photographs were taken and were presented by Mr. Marius Maxwell, author of "Stalking Big Game with

(*Continued on p.* 377.)

Supplement to NATURE

No. 3201 MARCH 7, 1931

Reviews.

A Trilogy of Science.

The Torch-Bearers. By Alfred Noyes. Vol. 3: *The Last Voyage.* Pp. ii + 229. (Edinburgh and London: William Blackwood and Sons, Ltd., 1930.) 7*s.* 6*d.* net.

THOSE who remember the interest with which we greeted the first volume of Mr. Noyes' "Torch-Bearers" seven years ago will understand the satisfaction with which the concluding portion is now received. This is all the greater because the third volume is certainly the best from the artistic point of view. It contains one well-conceived and highly interesting incident, around which the author's pictures of the past and incidental lyrics are effectively grouped, and it leads up to a full and eloquent exposition of the religious synthesis with which the history of science inspires him.

It will be recalled that the governing idea of the trilogy was to present the history of science as a connected whole; but, in view of the immensity of the subject and the need of some dramatic interest for poetic purposes, to select certain crucial moments and treat them with some fullness. In this way the first volume was made to turn largely round Galileo and Herschel and the second round the Darwinian controversy. The third has the advantage of a real incident in contemporary life as its central thread. A child on an ocean liner has to be operated on during the voyage. There is no first-rate surgeon on board; but communication is set up by wireless with another steamer, also in mid-ocean, on which one of the greatest experts happens to be sailing. The ship's doctor carries out the operation, under the directions of the other man; but the poet, as he reflects on what is going on, hears other voices, transmitted not only through space but also through time. The thought which is co-operating in the attempt to save the life of the child is really that of all the workers and thinkers in the world who have contributed to the skill and knowledge now put forth. Harvey speaks and Pasteur. Even the Chinese, whose culture of the silk-worm had a part in Pasteur's discoveries, find a place.

This is the true lesson of the poem, as it is of the growth of science itself:

> All this inter-dependent, intricate web,
> The invisible system of ethereal nerves,
> Connecting mind and hand with waves of will,
> Without which both were helpless, *whose are they?*

And the answer includes not only Gilbert, Galvani, Ampère, and all workers in physical science, "thousands of men, like cells in one organic brain", but also the still greater host who have worked at the sciences of life.

It is a dramatic idea of the highest imaginative value, thus to represent all this collective wisdom and will coming invisibly through the darkness to the cabin of a mighty modern ship to save the life of one small child: and it becomes a tragedy, when the child dies. Herein Mr. Noyes is faithful to the best canons of art. The human spirit, like the hero of ancient Greek tragedy, in such a case rises to the height of its powers, struggles to achieve its end, and is foiled by fate. Our admiration is by no means lessened, but touched, as Aristotle would have it, by awe and pity.

Mr. Noyes, however, goes further than the Greek tragedian or philosopher, in attempting to reconcile the failure of the particular action with the reasonableness and rightness of the whole. The poet, musing again after the child's death, discovers, after death had struck down the mortal body and the dear thing had vanished from the world which but half an hour ago had "outvalued all earth's kingdoms", that something else is needed to restore his sanity and his acceptance of the universe. This is the assurance which then comes to him from the infinite that there is a law and a love which will harmonise all catastrophes, and an eternal memory of which our human fragments are but parts. The

latter portion of the poem thus becomes a religious rhapsody, rather on Wordsworthian lines.

This concluding volume of the trilogy confirms our impression of seven years ago that Mr. Noyes has conferred a signal service both on English poetry and on science. The thing is beautiful and interesting in itself, and is bound, especially when it appears in one volume, to attract a large number of serious readers who would otherwise never connect the thought of science with that of poetry. It does this also in a novel way, not dreamt of by earlier poets, such as Wordsworth and Shelley, who hoped for an infusion of science in the language and images of poetry. Mr. Noyes turns rather to the idea of filiation which has become dominant in the last hundred years, and follows it out in certain episodes in the history of science, which is the field where it is best displayed.

Mr. Noyes' dramatic method of seizing striking incidents in the lives of men of science is the best calculated to rouse popular interest, though it has the disadvantage, from the philosophical point of view, of throwing into unfair relief certain persons, such as Francis Bacon and Renan in the present volume, whom the author chooses as foils for his heroes. But how, one may ask in palliation, does Julius Cæsar fare at the hands of Shakespeare, or Cromwell or Louis XI. at the hands of Scott? Let us be thankful for an art which makes vivid for us the clash of personalities in the past and, in Mr. Noyes' case, of personalities in a sphere hitherto scarcely touched by poets, and, as history, treated as a thing apart. In an age of specialism, when a synthetic spirit is the thing most needed, alike in politics and in thought, what could be more useful than to bring, as Mr. Noyes has done, poetry and history and science together in a careful, interesting, and at times very beautiful piece of work?

F. S. Marvin.

Vitalism and Mechanism.

The Nature of Living Matter. By Prof. Lancelot Hogben. Pp. ix + 316. (London: Kegan Paul and Co., Ltd., 1930.) 15*s.* net.

SEVENTY years ago, the then small educated public read Darwin's "Origin of Species" with such avidity that its first edition of 1250 copies was sold out on the day of publication. For twenty years from that date, biology, because of its obvious and direct bearing on the problem of man's place in Nature, was read and discussed by the general public. That continued interest was in large part due to the controversial vigour and literary ability of Prof. T. H. Huxley; but it was based on that aspect of the human mind which seeks an explanation of the apparent purposelessness of the universe and of human life with its joys and sorrows, distributed so capriciously and unfairly. This interest, long continued, died away, and has never been revived. But in its place has risen an interest far more widely spread and much less easily understood, in those modern developments of physics which depend on the relativity and quantum theories.

That modern physics should have excited such popular enthusiasm is due to the literary artistry of Sir James Jeans and Sir Arthur Eddington. They have explained, in simple language, results which can only be reached through that particular form of logic which is mathematics. But the climax to which this interest has risen since Eddington accepted the Principle of Indeterminacy, and as a corollary passed on to human behaviour and 'free will', shows that it rests on the same basis as the earlier vogue of biology, on religious 'instincts'. But, in that mathematicians are animals and that their technique of thought is in fact a phenomenon which falls within the scope of biology in its wide sense, it is certain that there must soon follow an appreciation of the human interest of the philosophical aspects of biology. These exist largely in the old controversy between vitalists and mechanists in the new form which it has received from Dr. J. S. Haldane and General Smuts. In the book under review, Prof. Hogben makes an ardent onslaught on these two writers, with sallies against many another biologist and minor campaigns against Whitehead and Eddington.

Prof. Hogben's point of view is that no biologist now claims, or will for generations, if ever, be able to claim, that all the phenomena of living things can receive a physico-chemical explanation; but that the only methods which will help to an understanding of the nature of living matter are in their nature identical with those which have proved so successful in the physical sciences. He adduces the work of A. V. Hill and Meyerhoff in illustration of the extent to which the experimental methods of physicists and chemists, with all the fundamental ideas from which these methods arise, can be carried when they are applied to the vastly complex but relatively simple problem of the activities of an isolated but living muscle. Through that work we have come near to establishing a balance-sheet of the energy exchanges which go on in a specific tissue, and have found

no reasons for introducing any conceptions which are foreign to physics or chemistry.

Prof. Hogben then passes on to an examination of our knowledge of heredity. We are entirely ignorant of the nature of the mechanism which determines the course of development of an animal. The experimental embryologists have sometimes localised that part of the embryo which, by its presence, initiates and controls the appearance of other parts: but of the nature of its influence, whether it depends on the diffusion of chemical substances, on changes in the surface of cells resulting from contacts, or on the establishment of differences of electrical potential, we know nothing. There are, indeed, few phenomena of living matter less likely to be expressible in physico-chemical terms than that of hereditary resemblances and differences.

Yet by methods which do not differ, except in their form, from those of students of physical science, it has become possible to analyse the varied results of breeding so successfully that a theory has been built up which enables the results of definite breeding experiments to be predicted. The prediction is a statistical one, but so are all chemical predictions. Prof. Hogben gives an admirable account of the evidence and the mode of reasoning which has enabled Prof. T. H. Morgan to establish the theory of the gene, the view that the things which determine the course of development of animals which, when adult, show mutations, are discrete particles, self-reproducing, arranged in a definite linear order in the chromosomes.

There remains, however, one field of biology which is still being investigated by methods involving conceptions totally unlike those of the physical sciences. The field of the psychologists, conscious behaviour, is still investigated by introspective methods yielding evidence valid only to the experimenter, and interpreted in terms of memory and preferences. The school of Behaviourists endeavoured to examine these phenomena by methods less unlike those of chemists, without securing general acceptance for their ideas and methods; but during the past few years the conditioned reflex method of Pavlov has for the first time enabled us to examine the behaviour of a dog, in circumstances which in ourselves would involve consciousness, by methods which do not differ in their fundamental character from those used in ordinary physiological experiment, and are capable of wide extension to other animals. The results which have already been reached by Prof. Pavlov's own school are of the utmost importance and show that part, at any rate, of the most secure redoubt of the vitalist is open to attack.

Prof. Hogben is a purist. To him no theory can be science unless it can be subjected to experimental substantiation. All else, if we understand him right, though it may be true, is not science but some other branch of learning. In Prof. Hogben's opinion, the characteristic features of scientific theories are that they are established on the basis of evidence which can at any time be reproduced and is accepted by all those who enter into the discussion. The discussion itself pays no attention to ethical implications, and is so conducted that personal idiosyncrasies play no part. It lies, in the author's phrase, in "the Public world".

But outside this, there are series of private worlds of æsthetics, religion, and philosophy, and between these no agreement can arise by public discussion, because the evidence valid for one man may justifiably not be accepted by another, and each man's view will be determined by his individual peculiarities.

Prof. Hogben's book should be read by all students of biology for its exposition of a point of view, and for its penetrating criticism of some current biological conceptions. It is, as a whole, brilliantly written; contains much wit, and some facetiousness; but is badly constructed, containing much repetition. It is, indeed, not that organised whole, a work of art. D. M. S. W.

De Generatione.

Early Theories of Sexual Generation. By Dr. F. J. Cole. Pp. x + 230 + 10 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 15*s.* net.

THIS interesting essay is one of the relaxations that Prof. F. J. Cole has allowed himself in the course of his labours on a "History of Zoology", and we cannot but hope that he may make yet other diversions of a similar nature, provided, of course, that the progress of the *magnum opus* is not unduly delayed. Sexual generation is a subject that the inquisitive mind has always been prone to play with, and thus the history is often very picturesque, even grotesquely so. This is well illustrated by the persistence with which observers, who should have known better, discerned and designed within the spermatozoon the lineaments of a fœtus.

One is glad to find that Leeuwenhoek remains the discoverer of spermatozoa (about 1677), neither Huygens nor Hartsoeker having any share in the honour. Mr. Ham, of whom Leeuwenhoek speaks, may have assisted; but he did not publish. Dr. Clifford Dobell, who furnishes a translation of Leeuwenhoek's historic letter, points out that it has been through a misinterpretation of words that Haller, with others after him, spoke of Hooke as demonstrating spermatozoa to Charles II.'s command. The minute motile things he demonstrated to the King were infusorians. There is often something delightful in the words used by the pioneers: thus in the semen of a ram the spermatozoa were seen "moving forwards in a troop with great gravity like a flock of sheep". We know that hundreds of typical spermatozoa may readily move about without jostling in a drop of fluid suspended from the head of a pin, and Leeuwenhoek says, "I judge a million of them would not equal in size a large grain of sand". As to shape, he compared a human spermatozoon to "a small earth nut with a long tail", and adds: "I have sometimes fancied that I could even discern different parts in the bodies of these animalcules; but forasmuch as I have not always been able to do so, I will say no more". Later on, as Dalyell puts it, "we descend from the observations of Leeuwenhoek to those of Buffon", and the bathos was reached by Pouchet, who described the "alimentary apparatus" of the spermatozoon. Even within the last hundred years Carus described the œsophagus, stomach, and intestine of the cephalopod spermatophore, and was not the great Kölliker trapped, like others, into regarding the discharged 'hectocotylus' arm as a complete male animal. Very shrewd was the suggestion of Treviranus, that spermatozoa were comparable to "animal pollen", but it was not until about 1841 that Kölliker gave the death-blow to the widespread theory that they were parasitic vermiculi. "It took over a hundred and sixty years of research to establish that the spermatozoa were not homunculi, or parasites with a complex organisation, but tissue elements of the animals in which they were found."

The *pièce de résistance* in Prof. Cole's fascinating book is the story of the preformation doctrine, for the first time told in a complete fashion, with the historical scenery that is needed to give a true perspective. We are shown that the preformation doctrine, an outgrowth of the Mosaic cosmogony, propounded the extraordinary view that there was no generation in Nature, but only the unfolding of a diminishing series of germs created at the beginning of the world. Inside the insect's cocoon there is a preformed insect, only requiring to be unfolded—born but not made. At earlier stages there is similar preformation, though it may be too small or transparent to be seen. Gaps were filled "by the mendacity of some and the mistaken credulity of others".

How was it that "for over a century the most popular theory of generation involved a denial that such a process actually existed, or that it afforded any scope for original research"? Partly because preformationism fitted in well with a wooden creationism; partly because microscopic research still remained very difficult; partly because attention was preoccupied with a few objects, like the pupa in its case, which suggested a preformed miniature organism, or even, in rare curiosities like *Miastor*, one generation inside another. But the main reason for the vicious parenthesis was really that, in spite of reawakeners like Vesalius, the scientific mood was still more than half-asleep as regards the problems of development. What a fine contempt there is in Von Baer's remark (1837) in regard to the theory of *emboîtement*: "Although this hypothesis borders on the insane, it has been advocated by very distinguished naturalists, and it affords a striking example of the aberrations into which one can fall if we systematically follow assumption rather than observation".

Prof. Cole gives the most scholarly account of preformationism that has yet been published; it is so perfect that we do not think that any more detail, or setting, or interpretation need be looked for in days to come, especially since the long-drawn-out absurdity, whether with or without *emboîtement* or encasement, bordered closely on the pathological. Of course he distinguishes the *ovism* of Swammerdam, Malpighi, Haller, Spallanzani, and Bonnet, who located the preformed fœtus in the ovum, from the *animalculism*, *spermatism*, or *vermiculism* of, say, Leeuwenhoek, who championed the spermatozoon; and to these two forms he adds a third, represented by Prévost, Dumas, and Rolando, who suggested that an imperfectly preformed embryo in the egg or in the sperm is completed by epigenesis. But this suggests a cross division of theories.

Prof. Cole is such a fine historian that we occasionally get a suggestion that his qualities in this direction outrun his biological acumen. Thus he arranges the various theories of generation prevalent in the seventeenth and eighteenth centuries as: (1) pangenesis; (2) precipitation; (3) semin-

ism; (4) preformation (*Vorbildung*); (5) epigenesis (*Nachbildung*); and (6) panspermy; but this does not strike us as a convincing grouping. Thus, 'precipitation' is a very different *kind* of theory from 'panspermy', which is practically the same as abiogenesis. Again, we do not feel at all convinced that Darwin resuscitated the ancient theory of pangenesis, which accounted for the germ by assuming contributions from all parts of the body. For Darwin recognised the existence of the *sexual elements*, and evidently thought of them not only as receiving gemmules from their bearer's body, but also as receiving them in a dormant state from preceding generations (see "Variation of Animals and Plants", 1868, vol. 2, p. 402, etc.).

Then again, is there not a risk of confusion in the learned author's suggestion that modern advances are leading us behind a descriptive epigenetic embryography to an explanatory preformationist embryology? For modern genetics is so utterly different from the old preformationism that the use of the old word is almost perverse. Moreover, even the general idea is on another plane, for we think of developmental initiatives liberating other initiatives in a long succession, not of simultaneity of original equipment.

The chapter on fertilisation is a fine piece of work, but its very excellence leads us to suggest for another edition that all these stories of fumbling tentatives would be more educative if they ended, ever so shortly, in a statement of the modern position. Thus we get so much intrigued with early theories of like begetting like that we almost demand Weismann's continuity of the germ plasm; and so with fertilisation. But the book is none the less deserving of being called masterly.

J. A. T.

In Mesopotamia during the War.

Loyalties: Mesopotamia 1914–1917; a Personal and Historical Record. By Lieut.-Col. Sir Arnold T. Wilson. Pp. xxxvi + 340 + 28 plates. (London: Oxford University Press, 1930.) 25*s*. net.

CONSIDERING the never-ending spate of books dealing with the multitudinous aspects of the Great War, world-wide as it was, with a story in every continent, it is curious to reflect that the struggle in Mesopotamia has had until now no competent historian. Sir Arnold Wilson, who lived and moved and had his being in those epic years in the Middle East, is peculiarly fitted to describe the moving pageant of the War in that theatre, since he, above all others, had the responsibility of making effective the civil administration that step by step followed in the wake of the military arm. By training a soldier—and a distinguished one—by race and instinct an administrator of insight and vision, he is admirably qualified to make clear "a tale of great deeds by land and river, sea and air, of suffering and endurance, and faithfulness unto death on both sides, in pursuit of objects dimly seen, and of aims but darkly understood".

It is the particular genius of the English to be able to implant and nourish the seeds of political organisation and of the broad principles of tolerant governance in whatever spheres they are placed, and Sir Arnold's thesis is, in effect, a dissertation on the creation of the mechanism of administration in a land newly conquered, and amongst a people indifferent, if not at first actively hostile. To readers of NATURE the characteristic impact on affairs of botanists, geologists, bacteriologists, entomologists, hygienists, and chemists is at least equal in interest to the story of the military occupation and the subsequent pacification and orderly organisation. Sir Arnold was quick to see the importance of enlisting every scientific arm into the general service, and hard on the heels of the purely political officer followed men, often with difficulty extricated from the ranks of the forces, whose special aptitudes fitted them for the even more urgent scientific functions in this field. Sanitation, water purification, attack on parasites, bacteriological investigations, geological surveys, siting of quarries, and innumerable other problems of first importance for the health and well-being of the great armies in Mesopotamia, were solved by the efforts of this devoted band.

Of the darker side of the campaign the author has, in a characteristically reticent way, conveyed a sufficiently serious message to the nation in particular and to civilisation in general. Mismanagement unhappily is common to all human effort, but never was it more apparent than in the breakdown of the medical service in Mesopotamia, though Sir Arnold pays a notable tribute to the services of Dr. (now Sir William) Willcox in bringing the resources of science to bear on delicate problems of diagnosis and prophylaxis. Quoting from the Report of the Commission in 1917:

"The medical provision . . . was from the beginning insufficient. . . . By reason of the continuance of this insufficiency there was a lamentable breakdown in the care of the sick and wounded. . . . The defects of medical provision caused avoidable suffering to the sick and wounded, and during the breakdown of the winter of 1915–16 this suffering was most lamentably severe."

Even worse is the harrowing story of the survivors of Kut. "The scene at Baghaila was one of anguish and misery. The march itself (from Kut) was a nightmare. The Arab soldiery used sticks and whips to flog the stragglers on. Some have been thrashed to death, some killed . . . some left to be tortured by the Arab. . . . Every now and then we stopped to bury our dead." 2592 British rank and file left Kut; 1700 died in captivity. Such was 'the gentlemanly' Turk; but "The General Staff in Mesopotamia . . . discredited every report of brutality or cruelty till the bitter truth could no longer be hidden". The reviewer has purposely quoted these terrible details of the grimmer aspects of the War to direct attention to a chapter which is written with a restraint and a latent fire that render it one of the most effective exposures of a foolish tradition ever put forward.

It remains finally to congratulate the author on the achievement of a living history. It would be supererogatory to direct attention to the easy flow of its style, to the wealth of knowledge and sympathy enshrined in it, to the reticence of a man who feels deeply, and felt deeply, in telling and recalling its moving story. It is a book that no Briton should fail to read, and in reading, to anticipate with no less interest the sequel that will deal with the later history of the War and the notable and fruitful scientific services in connexion with agricultural and mineral development, aviation, and preventive hygiene. A. E. D.

Biological Catalysts.

Enzymes. By Prof. J. B. S. Haldane. (Monographs on Biochemistry.) Pp. vii + 235. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 14*s.* net.

THIS book marks a new departure in the series of Monographs on Biochemistry, additions to which have appeared at intervals since its happy inauguration in 1908, for the subject has already been treated in an earlier volume of the series, Bayliss's "Nature of Enzyme Action" (1908), the last edition of which from its author's hand appeared in 1925. As the present author points out, Bayliss's book was strongly individual, and it was rightly thought that an entirely new work would be better than an attempt by an alien hand to bring Bayliss up-to-date. Bayliss's main thesis was that enzymes act as colloidal catalysts and combine with their substrates and other substances by adsorption, "so that the action of enzymes in general must be regarded as exerted by their surface", and a large part of his book was devoted to the support of this view. In the present work this position is assumed almost without discussion, though it is carefully pointed out that "the assumption that an enzyme molecule activates only one substrate molecule at a time has worked remarkably well".

In the new book, the influence on enzyme action of such factors as enzyme concentration, hydrogen ion concentration, temperature, radiation, and the union of the enzyme with its substrate and other compounds is first considered. Then follows a chapter on the course of enzymatic reactions and its mathematical theory, treated with a profusion of mathematics which implies a high, and we hope well deserved, compliment to the attainments of the readers of the book. Interesting chapters follow on specificity, coenzymes and other adjuvants, the 'poisoning' of enzymes, and the purification of enzymes; and the work is concluded by a chapter on the theory of enzyme action and classification.

Throughout the book a wealth of examples is brought forward, which fully justifies the author's reputation for an encyclopædic knowledge of the literature, but sometimes leaves the reader a little breathless. A number of tables are included, in which a great mass of information is usefully summarised.

The author, perhaps wisely, avoids generalisations, but it can be gleaned from his pages that he regards enzymes, defined as soluble, colloidal, organic catalysts produced by living organisms, as capable of combining with their substrates, owing to the chemical structure of the latter, and also with at least one of the products of the reaction catalysed. In this combination the substrate molecules do not, in general, cover the whole surface of the enzyme. The substrate in this situation requires the addition of less than the usual amount of energy increment to enable it to undergo the chemical change in question. The reason for this is not definitely known, but the author makes an interesting suggestion, and Quastel's theory of active centres provides another. The fundamental question as to the exact structure which renders an enzyme capable of exerting its specific effects has not yet been answered.

Biochemists have every reason to be grateful to the author for the abundance of material which he has put before them, and for the careful and logical way in which he has treated it.

ARTHUR HARDEN.

Birds of Africa and Asia.

(1) *Nicoll's Birds of Egypt.* By Colonel R. Meinertzhagen. Published under the Authority of the Egyptian Government. Vol. 1. Pp. xvi + 348 + 19 plates. Vol. 2. Pp. 349-700 + 19 plates. (London: Hugh Rees, Ltd., 1930.) 30*s.*

(2) *The Game-Birds of India, Burma and Ceylon.* By E. C. Stuart Baker. (Published by the Bombay Natural History Society.) Vol. 3: *Pheasants and Bustard-Quail.* Pp. x + 341 + 20 plates. (London: John Bale, Sons and Danielsson, Ltd., 1930.) 42*s.* net.

(3) *A Handbook of the Birds of Eastern China (Chihli, Shantung, Kiangsu, Anhwei, Kiangsi, Chekiang, Fohkien and Kwangtung Provinces).* By J. D. D. La Touche. Part 5: *Containing Families Motacillidæ, Alaudidæ, Zosteropidæ, Nectariniidæ, Dicæidæ, Pittidæ and Eurylaimidæ.* Pp. 399-500 + xx + 2 plates. (London: Taylor and Francis, 1930.) 7*s.* 6*d.* net.

(4) *Coloured Plates of the Birds of Ceylon.* By G. M. Henry. With a Short Description of each Bird by W. E. Wait. (Published by the Ceylon Government.) Part 3. Pp. iii + 16 + 16 plates. (Colombo: Colombo Museum; London: Dulau and Co., Ltd., 1930.) 30*s.*

(5) *Systema Avium Æthiopicarum: a Systematic List of the Birds of the Ethiopian Region.* By William Lutley Sclater. Prepared in conjunction with Special Committees of the British and American Ornithologists' Unions. Part 2. Pp. iii + 305-922. (London: Taylor and Francis, 1930.) 21*s.*

THE titles above are evidence of the progress being made towards a conspectus of the world's avifauna. For one country or region after another, books are steadily appearing which collate, for their respective areas, information which was previously either unavailable or else widely scattered in the ornithological journals: in some cases they break fresh ground, while in others they replace older works now out-of-date. The particular volumes here to be discussed range from Africa to the Far East.

(1) Pride of place must be given to the work on Egyptian birds which Col. Meinertzhagen has compiled upon foundations laid by the late Michael Nicoll. Unlike the others mentioned, it is issued complete—in two volumes simultaneously published. It is also, both in form and content, one of the most admirable bird-books of recent years. The volumes are of sumptuous size, well bound, and printed in a manner which leaves nothing to be desired. In addition to numerous text-figures and three useful maps, there is a series of photogravures and very beautifully coloured plates excellently reproduced. In these circumstances, thirty shillings for the two volumes together must be regarded as an extraordinarily low price.

The fine production is justified by the quality of the subject matter. Nicoll had been assistant director of the Zoological Gardens at Giza for eighteen years when ill-health compelled him to retire in 1924 and led to his death in the following year, at the age of forty-five years. During that period he had published a "Handlist of the Birds of Egypt" (1919) and had amassed much material for this larger work. His task has now been very ably completed by Col. Meinertzhagen, who has not only cast the whole into proper form, but also has supplemented the information from his own field experience in Egypt and by further study of the specimens available in Nicoll's collection and elsewhere. The result must certainly rank as a very valuable addition to ornithological literature, and it well fulfils the author's desire to provide a worthy memorial to his friend.

The bulk of the work naturally consists of accounts of the individual species; these are systematically arranged and provided with useful identification keys. A series of appendices tabulates the birds according to their status—the residents, the few summer visitors coming from the south to breed, and the very numerous species from the north and north-east that visit Egypt on passage or for the winter.

Unlike many authors of such works, however, Col. Meinertzhagen is not content with merely systematic treatment of his subject. He rightly asserts the necessity for using the data in some approach to general biological problems relevant to the area, and he proceeds to give practical effect to this view in several introductory chapters of much interest. The first volume opens with accounts of the physical geography and the geology of the country. There follows a brief general dissertation on the theory of evolution, but this does not seem altogether necessary and scarcely does justice to the complexity of that subject. The author is on firmer ground when he discusses the origin of life in Egypt. There are three principal types of country to be considered. The oases, first, are regarded as the relics of a former rain-watered area of wide extent; desert, secondly, has largely supervened; and, thirdly, the Nile valley and delta are of still more recent origin. In the first and third of these habitats, the

avifauna is mainly of Palæarctic type, but with a strong tropical flavour due to species which have either remained from pre-glacial times or have come from the south more recently with the development of the Nile valley. On the other hand, the true desert avifauna is considered to have spread from the east.

The chapter dealing with migration to, from, and in Egypt is of especial value and raises many points of general interest. It includes a section on the difficult questions of sex and age in relation to migration, and of the possible influence of moult. Mr. R. E. Moreau contributes a section to this chapter on migration, and also a well-illustrated chapter on the birds of ancient Egypt as known from inscriptions, mural decorations, and mummified specimens. Finally, there is a chapter in which Col. Meinertzhagen deals with practical questions of bird protection in Egypt.

(2) Mr. Stuart Baker's third volume on Indian game-birds, dealing with the pheasants and bustard-quail, follows its predecessors after an interval of nine years, a delay possibly due to the author's preoccupation with his greater work on "The Fauna of British India", of which the eighth and final volume has also recently appeared. The present book aims, on one hand, at giving a scientific review of the birds which form its subject, and, on the other, at providing a useful guide to sportsmen. It admirably fulfils both purposes, as was to be expected from an author who is not only a recognised authority on Indian ornithology but also a well-known game shot. The volume is handsomely made up and well illustrated.

(3) With the fifth part of his handbook, Mr. La Touche completes his first volume and also his account of the passerine birds of eastern China. This work is on a less ambitious scale than those mentioned above, containing, for example, no figures of the species; but it gives adequate descriptions of the birds, as well as accounts of their distribution in the region, and it should serve a useful purpose.

(4) Mr. Henry's work, on the other hand, consists almost entirely of illustrations. The sixteen plates from his brush are of a high order of merit and have been excellently reproduced in colour. The object has been to depict a series of birds characteristic of Ceylon. The majority of the species or sub-species selected are indeed peculiar to the island. To each plate there is a brief annotation by Mr. W. E. Wait, to whose "Manual of the Birds of Ceylon" (1925) this work may in some sense be regarded as a pictorial supplement.

(5) Mr. Sclater's "Systema" is a work of reference in its severest form—invaluable to serious students dealing with African ornithology, but necessarily making no general appeal. It is a classified catalogue of the birds of the region, the volume now before us dealing with the passerine birds and comprising more than four thousand forms. The author is to be congratulated on the completion of a most laborious task. His work bears the stamp of authority and will serve as a base-line for further systematic work for a long time to come.

It is worthy of note that both Col. Meinertzhagen's and Mr. Henry's works are published under the auspices of the governments of the countries concerned. The same applies to Mr. David Bannerman's "Birds of Tropical West Africa", of which the first volume was recently reviewed in these pages. Without this support, the publication of such books would often be impossible.

X-Rays and their Applications.

(1) *X-ray Crystallography.* By R. W. James. (Methuen's Monographs on Physical Subjects.) Pp. vii + 88. (London: Methuen and Co., Ltd., 1930.) 2*s.* 6*d.* net.

(2) *Les rayons X: théorie et applications.* Par Dr. Jean Thibaud. (Collection Armand Colin: Section de physique.) Pp. 218. (Paris: Armand Colin, 1930.) 10·50 francs.

(3) *Les applications des rayons X: physique, chimie, métallurgie.* Par Dr. J.-J. Trillat. (Recueil des Conférences-Rapports de documentation sur la Physique.) Pp. 298 + 16 planches. (Paris: Les Presses universitaires de France, 1930.) 85 francs.

(4) *X-ray Technology: the Production, Measurement and Applications of X-rays.* By Dr. H. M. Terrill and Dr. C. T. Ulrey. Pp. viii + 256. (London: Chapman and Hall, Ltd., 1930.) 21*s.* net.

(5) *Handbuch der Experimentalphysik.* Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 24, Teil 1: *Allgemeine Physik der Röntgenstrahlen.* Von Fritz Kirchner. Pp. x + 548. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 55 gold marks.

RÖNTGEN'S discovery of X-rays at the end of the year 1895 began a new era in the history of scientific investigation. Few discoveries have so speedily been followed by important benefits to mankind in connexion with medicine and surgery, and by equally important theoretical advances. It is no exaggeration to say that our present knowledge of the structure of the atom dates from 1895,

for not only did the X-rays provide a convenient means of producing ionisation in a gas, but also by their penetrating power they suggested that search for other penetrating radiations which resulted in the discovery of radioactivity. Yet on looking back it seems somewhat strange that there should have been such a long interval—about seventeen years—between the first discovery of X-rays and the introduction of a crystal as a three-dimensional diffraction grating for the analysis of the rays. We may recall the fact that there was a slightly longer interval a century earlier between the invention of the voltaic cell and the discovery of the magnetic action of the current by Oersted. To the intuition of von Laue (1912) we owe the X-ray spectrograph and the marvellous developments which have followed from its introduction by the Braggs and its improvement by other workers.

(1) Mr. R. W. James, who has had experience in Prof. W. L. Bragg's laboratory in the University of Manchester, has written a very good monograph on X-ray crystallography. He has dealt with general methods rather than with their application to particular cases, and in consequence his little book should serve as a useful introduction to the standard works listed in the bibliography. "It is now clear that the type of regular arrangement formerly associated only with definite crystals is characteristic of all true solids, and that the study of crystal structure is really the study of the architecture of matter in the solid state." He begins with a description of crystal form and the space-lattice, and then considers the crystal lattice as a diffraction grating. The longest chapter is that on the symmetry of crystals and its determination by means of X-rays.

Natural crystals may be regarded as mosaics of more or less perfect blocks, which, although nearly parallel, may vary in orientation over a small range of angles. If suitable material is available, the size of the unit cell can be determined and the space-lattice investigated by examining a large number of spectra and noticing systematic absences of spectra of a general type. It is usually possible to determine also the space-group, the scaffolding of symmetry planes and axes upon which the structure is built.

To find the exact positions of the atoms it is necessary to study the intensities of the X-ray spectra, and the extremely interesting chapter on this subject reveals some of the difficult problems with which the investigator has had to deal in interpreting his results and the skill with which these questions have been attacked. "Each crystal is a separate problem, and the success obtained in determining its structure depends largely on the skill and experience of the worker."

In the final chapter, on types of crystal structure, the author considers some of the more noteworthy results of crystal analysis, dealing in particular with simple metallic and ionic crystals, complex ions, the silicates, and lastly, molecular and organic crystals.

(2) Dr. Jean Thibaud has carried out successful pioneer work on the properties of the soft X-rays, having designed a grating spectrograph by means of which he has helped to bridge the gap between the ordinary X-ray region and the ultra-violet. If the grating is calibrated by means of a line in the visible or ultra-violet spectrum, the wave-lengths of X-rays can be determined and the grating constant of a crystal can be deduced. Thus the measurements provide an independent estimate of Avogadro's constant and the fundamental electron charge.

In the volume before us, Dr. Thibaud has provided a compact and lucid account of the theory and the applications of X-rays. The book is divided into four parts, the first dealing with X-rays considered as electromagnetic radiations, the second with X-rays as quanta, the third with the technique of the rays and their practical applications, and the last part containing a short account of related rays such as the gamma rays and the 'waves' of L. de Broglie. The volume forms an admirable introduction to the science of X-rays, which, as the author points out, has led not only to deep philosophical speculations as to the structure of matter but also to a long series of technical and industrial applications.

(3) Dr. J.-J. Trillat has written a comprehensive treatise on the applications of X-rays in physics, chemistry, and metallurgy, special attention being paid to the more recent developments. The book is divided into two parts of unequal length. In the first part, extending to about one hundred pages, the author deals with generalities necessary for understanding the following chapters. The methods of producing X-rays are discussed at length, and a detailed description is given of the apparatus and methods employed in X-ray spectrography.

In the second part of his work, Dr. Trillat describes the various applications of X-rays in the domain of physical chemistry and in industry. The most significant feature of this part of the book is the great development which has taken place in the application of the rays to the study of organic compounds, including colloidal sub-

stances, cellulose and its derivatives, caoutchouc, resins, gelatins, etc. The sixteen plates which illustrate the book are very striking, and show the great advances which have been made in recent years in the technique of the subject.

(4) In the volume by Drs. Terrill and Ulrey the practical rather than the theoretical aspects of X-ray measurements are presented. Many of the problems discussed are common to all X-ray laboratories, but particular attention has been given to the quantitative measurements involved in X-ray therapy and in industrial applications. The subject has advanced to such a stage that a considerable portion of the contents may be properly classified as X-ray engineering. The book is specially valuable for the practical hints which it contains regarding the construction and use of apparatus, and mention may be made of the descriptions of various forms of tubes and of the precautions to be observed in exhausting them so that they may be sealed off from the pump.

The temptation to quote interesting statements is great, but only a few can be given. In the highest vacuum attainable to-day (about 10^{-4} bar) there are still more than a 'billion' (10^9) molecules in each cubic centimetre. A very small part of the energy of cathode rays, only one or two tenths of one per cent, comes out of the target in the form of X-rays. Lenard ray tubes have recently been constructed with thin glass windows of about 0·001 cm. thickness which can still support atmospheric pressure. The emergent rays can thus be produced at lower voltages than when windows of denser metals are used. This book should be of great service in the laboratory.

(5) The large volume on Röntgen rays in the "Handbuch der Experimentalphysik" is written by Dr. Kirchner, of Munich, and includes the general physics of the phenomena associated with the rays, but not the subjects of X-ray spectroscopy and crystal analysis, which are treated in separate volumes. The book falls into three parts, the first dealing with the production and measurement of the rays, the second with electron emission produced by the rays and the accompanying phenomena, and the third with the scattering of the rays. We have here a very complete account of the subjects treated, including the earlier as well as the more recent researches.

Of special interest are the chapters touching upon the Compton effect, in which a quantum of primary radiation colliding with a *free* electron recoils from the impact with diminished energy and therefore lower frequency. It is no longer possible to doubt the reality of this effect, now confirmed by so many investigations, and in consequence the classical electromagnetic theory can no longer be considered adequate for the explanation of the relations between electrons and radiation. Some form of the quantum theory must necessarily be accepted. H. S. Allen.

Sound and its Uses.

(1) *A Textbook of Sound: being an Account of the Physics of Vibrations with special reference to recent Theoretical and Technical Developments.* By Dr. A. B. Wood. Pp. xiv + 519. (London: G. Bell and Sons, Ltd., 1930.) 25*s.* net.

(2) *Sound Waves and their Uses: Six Lectures delivered before a "Juvenile Auditory" under the auspices of the Royal Institution, Christmas 1928.* By Dr. Alexander Wood. Pp. x + 152. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 7*s.* 6*d.* net.

(1) In reading acoustical literature, it is, at times, difficult to avoid an impression that the publication of Rayleigh's masterly treatise, "The Theory of Sound", tended to exert a harmful influence on the subject as a whole. Thus, in the preface of the latest text-book on sound, we find its author writing: "The change which has taken place during the past ten or twenty years in the study of mechanical vibration and sound is my excuse for writing this book when such treatises as those of Rayleigh and Lamb already exist". Since a complete physical theory of a phenomenon is only obtained when mathematical and experimental work both yield the same quantitative results, the two treatises referred to should never be regarded as treatises on sound, but only as treatises on the *theory* of sound. The justification for Dr. Wood's book is not merely his description of the recent advances in sound, but rather his skill in giving equal importance to experiment and to theory.

Until quite recently, sound suffered from the fact that its mathematical theories had far outstripped experimental technique, which had to wait for the development of the thermionic valve and those electrical instruments of similar delicacy the applications of which are so well described in the present volume. Before their appearance, the mathematicians had become too impatient, as can be well illustrated by a particular problem—that of the struck string. Helmholtz gave two theoretical treatments which were never tested experimentally. Rayleigh felt justified in writing of

them, "Helmholtz has obtained a solution representing all the essential features of the case". Now it is no exaggeration to say that, to correct this statement, "none of" would have to be substituted for "all". The validity of any particular theory of the struck string is of little importance; but it is surely of fundamental importance to realise that quantitative agreement between experiment and theory is an essential test of the validity of any theory. The appearance of a correct piece of mathematics in Rayleigh's "Sound" is no guarantee that it necessarily represents Nature's behaviour in the particular phenomenon concerned.

Dr. Wood's book is thoroughly modern in outlook and covers all branches of the subject with the exception of musical instruments. Such subjects as relaxation oscillations and power considerations, which are not found elsewhere, receive adequate attention here. Even so classical a subject as the transverse vibrations of strings is thoroughly revitalised by a discussion of the electromagnetic means of excitation, the Dye sonometer capable of measuring or adjusting an electrical frequency with an accuracy of 1 in 1000 over a considerable range, and the latest Einthoven string galvanometer with its string only 1 mm. long, stretched in a high vacuum (less than 10^{-3} mm. of mercury), and tunable to radio frequencies of the order 3×10^5 cycles per second. In the discussion of sources of alternating current, no mention is made of the various gramophone records available for this purpose. It is a pleasure to note that in the chapter on technical applications, including the measurement of distance by sound, acoustics of buildings, the gramophone, sound films, and alternating power transmission by the Constantinesco system, four pages are devoted to the problem of noise reduction.

Not only is this text-book the best so far produced on its subject in any language, but also, in the skilful blending of theory and experiment and in the careful statement of assumed initial and boundary conditions and factors omitted from a particular treatment, it forms a model of the ideal text-book.

(2) Dr. A. Wood's book founded on the Royal Institution 1928 Christmas Lectures is a popular, well-illustrated account of sound waves and some of their uses. The first lecture on waves introduces no new experiments, and Fig. 6 is quite Victorian. In the course of the second lecture, dealing mainly with signalling in air and water, data are given of the efficiency of various sound sources, from which it appears that the human voice with an efficiency of only one per cent is one of the best. The remaining lectures deal with musical sounds, sound analysis, hearing, and sound recording and reproduction. At the end of each chapter is an extensive bibliography; that at the end of Chap. vi. includes references which show that the gramophone sound-box reproduced as typical in Fig. 129 is out-of-date.

Although the work is an attractive presentation of interesting facts, it gives nothing more than the facts. The uses of sound waves dealt with are chiefly those which would foster the impression that science is 'the hewer of wood and drawer of water' for humanity. Too little attention is given to the most important use of sound in the rapid communication of thought; and may we not also include the effect produced upon music-lovers by a symphony or a string quartet as an important use of sound? In so hackneyed a subject for popular lecturing, one would have liked to see the facts of the lectures used as propaganda for the cause of pure science, or as a means of demonstrating scientific method, science as a way of thinking and reasoning. The discussion of the silent zone in the second lecture, for example, would have served admirably for this latter purpose. The publication of such a book as this, a collection of facts, without an index, is unforgivable. W. H. George.

Line and Band Spectra.

(1) *The Structure of Line Spectra.* By Prof. Linus Pauling and Prof. Samuel Goudsmit. (International Series in Physics.) Pp. x + 263. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 17*s.* 6*d.* net.

(2) *Band Spectra and Molecular Structure.* By Dr. R. de L. Kronig. Pp. x + 163. (Cambridge: At the University Press, 1930.) 10*s.* 6*d.* net.

BOOKS dealing with modern physics can often be divided into two classes. Into one category fall those which are conscious throughout of the reader's infirmities (real or imaginary), while in the other will be found those works—full of intellectual honesty—which face the facts and leave the aspirant to strike out for himself as best he may, even though he is certain to meet with heavy weather. Such a classification is reasonably well illustrated by the two books before us; into the first group goes the volume by Profs. Pauling and Goudsmit, and into the second that by Dr. Kronig.

(1) "The Structure of Line Spectra" is true to its title, in that the atom receives nearly all the attention. The authors frankly state their prefer-

ence for the vector model, and base the whole of their treatment upon it. Much space in the early part of the book is occupied by discussions about orbits (in Bohr's sense), followed by the conventional introduction to the simplest application of the wave equation. This being so, it is a little difficult to see why we might not have been spared the orbits in their unregenerate guise and thus create more room for enlarging the section on quantum mechanics. As it is, the stationary states of the hydrogen atom and the equations describing them on the older quantum theory appear to serve no useful purpose.

The following chapters deal adequately with the usual applications of the vector model to alkali-like atoms (with the appropriate extensions), intensities, the Pauli *Verbot*, hyperfine structure, and nuclear moment. A decidedly good account of Hund's work on the magnetic moments of ions of the rare earths and the causes of the failure of the theory for the transitional elements will be found in the last chapter. This subject is exercising many minds at the present stage of development of spectroscopic conceptions in relation to chemical statics.

Taken on the whole, the volume should find a place on the shelves of a certain type of worker: there may be more such workers in the United States than in Great Britain. One sympathises with the authors' objects in writing the book; but it tends to fall between two stools, in being a trifle too specialised for the able honours man in his last year, and yet too staid for the research worker who has any hopes of possessing or acquiring a *flair*. He will go to the sources themselves, cost what it may.

(2) Dr. Kronig's "Band Spectra and Molecular Structure" consists of a series of lectures given at Trinity College, Cambridge, in 1929. Those who had the privilege of hearing them will recognise in the printed page the masterly grasp and rigour of the author. He never for one moment permits himself to be deflected from the fundamentally theoretical nature of his subject, though a few kindly asterisks warn the weaker brethren when they may—with detriment it is true, but without abandoning salvation—omit paragraphs dealing, for the most part, with purely mathematical machinery. In a word, it approaches the ideal book, and one wishes that there were more of it.

The spectroscopist, in dealing with the molecule, has evolved a method whereby he is able to picture his assemblage as having three kinds of energy levels —(*a*) electronic, in which the nuclei are treated as fixed centres of force at a certain distance ρ apart; (*b*) vibrational, in which ρ is no longer a constant, so that the nuclei move to and fro along a straight line; and (*c*) rotational, in which the nuclei can take up any position in space. The mathematical justification for classifying these energy levels by means of quantum numbers demands, as might be expected, the neglect of small terms in the Hamiltonian H, where H is a differential operator in the wave equation $(H - W)\psi = 0$.

The application of perturbation theory leads to a knowledge of the influence of these rejected terms, that is, an understanding of the rotational distortion of spin multiplets and the so-called Λ-doubling in rotational levels. The minor terms are also of importance for the phenomenon of pre-dissociation.

A chapter on the macroscopic properties of molecular gases is very welcome, in which Dr. Kronig discusses the modern views on magnetic susceptibilities and specific heats. Finally, some space is devoted to the newer theories of chemical combination, with special reference to homopolar molecules.

If a couple of very minor criticisms may be made, it is only with the object of making the book quite indispensable. One is that in a future edition the bibliography might be brought as up-to-date as it is possible to bring it (the present one ends at November 1929, which is a somewhat remote date as physicists count time in these days for a work published in October 1930); and the other that an author's index should be provided, particularly to references in the body of the text. One not infrequently knows the name of an investigator without being quite sure what precisely he investigated. Dr. Kronig's volume is the obvious place in which to look, and to find massive learning combined with great lucidity. F. I. G. R.

Qualitative and Quantitative Analysis.

(1) *Analytical Chemistry.* Based on the German Text of Prof. F. P. Treadwell. Translated and revised by Prof. William T. Hall. Vol. 1: *Qualitative Analysis.* Seventh English edition, revised. Pp. ix + 610. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 23*s.* net.

(2) *Select Methods of Metallurgical Analysis.* By Dr. W. A. Naish and J. E. Clennell. Pp. xii + 495 + 9 plates. (London: Chapman and Hall, Ltd., 1929.) 30*s.* net.

(1) ALTHOUGH Treadwell's work is now a classic, there have been some changes and improvements in the present edition which seem to call for description. There is, first, a concise but clear account of the fundamental physico-

chemical theories, with examples of their applications to analytical chemistry. In the section on electrode potentials the American system of signs is adopted. It is the opposite of that used in Europe, and although each system has advantages in particular aspects of the matter, it is desirable that a common system should be reached by agreement. In the numerical tables there is, of course, the additional complication of the definition of the normal state.

The solubility product relation, with useful numerical examples, is discussed in a critical manner on pp. 21-3, and a comprehensive table of solubility products, together with the solubilities in pure water calculated from these values, is given. The American editor points out that the values in the literature are not in good agreement, but it is evident that he has used a good deal of judgment in the selection of the values which appear in his table.

On pp. 461-2, however, reference is made to another table of solubility values given in a recent German edition of Fresenius's "Qualitative Analysis", with the remarks that "there is no mention of how the values were obtained", but that "the data given in the German text doubtless represent many hours of careful, accurate, and skilful analytical work". These values are, however, merely compiled from a part of Landolt-Börnstein's tables other than that used by the American author in the preparation of his table. The differences are startling; for example, in the case of cupric sulphide, one value in Landolt-Börnstein is $3{\cdot}6 \times 10^{-4}$ gm./lit. and another is $8{\cdot}7 \times 10^{-21}$ gm./lit. Prof. Hall considers that the lower values for the solubilities of sulphides better represent the behaviour of these substances in qualitative analysis.

The preparation of reagents (in which the desirability of using solutions of known strength is emphasised) and the reactions of the more common metals and acids follow, and in the latter section (which occupies most of the book) it is satisfactory to find practically all the newer tests which seem likely to have a permanent value. On p. 88 there is some confusion, in the description of Ball's reagent, between nitrites and nitrates. The division of the metals into groups follows the classical scheme, and there is no doubt that, with the average student, this gives very satisfactory results. Alternative schemes of separation of the constituents of a group are also given, the notes on these separations being full and informative, and a most valuable feature of the book. The acids are dealt with on the basis of a scheme due to Bunsen, depending on the properties of the silver and barium salts.

Pages 497-567 deal with the reactions of some of the rarer metals, a subject which is becoming increasingly important in view of the extending use of these elements in industry. The analyst who omits to test for elements like molybdenum, tungsten, titanium, and vanadium may overlook the most essential part of the material in his hands. The book closes with a scheme for the detection of all metallic constituents, adapted from the work of Noyes and Bray ("Qualitative Analysis for the Rare Elements"; New York, 1927).

It will be seen that the new edition of Treadwell's "Qualitative Analysis" is one which, in the hands of teachers and of more advanced students, will be found of the greatest utility, and it provides a valuable work of reference. For the elementary student it is, of course, too detailed, but it is suitable for students who have completed a course of intermediate standard. The amount of information contained in the book is astonishingly large, and from this point of view the price, although somewhat high for the student, is reasonable.

(2) In an introduction to Naish and Clennell's book, Sir Harold Carpenter points out that the work is one which will be useful to professional metallurgists, assayers, chemists, and students, principally because the methods it describes have been selected on account of their accuracy and their general suitability for the purpose in view. Most of these methods have been actually tried out by the authors themselves, and this considerably enhances the value of the work, distinguishing it from so many of the often careless, expensive, and tedious compilations, with little exhibition of critical faculties on the part of the authors, which continually pour on the scientific book market, and particularly from Germany. Another valuable feature of the present work is that equal prominence is given to both the rare and ordinary elements. As Sir Harold Carpenter says, the majority of modern works on analysis ignore many of these elements, yet "if experimenters were to examine their specimens more frequently for the rare elements, they would probably be detected in many minerals and metallurgical products in which they are not suspected". It is within the reviewer's knowledge that vanadium in an industrial product has more than once been returned as 'copper' by chemists of considerable ability.

It may be agreed, therefore, that the aims of the book are sound, and that the choice of topics is sufficiently wide to make it applicable to most metallurgical materials. The only matter which calls for detailed comment is how the methods proposed by the authors are likely to work in the laboratory. Chapters on mineral analysis, electrometric titrations, and spectrographic methods have been contributed by specialists, from which we may conclude that such methods are not yet in common use in the metallurgical laboratory, since otherwise they would have fallen within the experience of the main authors, who, nevertheless, consider them "to be of the greatest interest and value to metallurgical chemists". The reviewer has tested the remaining text by looking up a few problems in quantitative analysis in which he has been interested and which are not dealt with in the ordinary books. In all cases, a method was described which had every appearance of reliability. The details given in nearly all the descriptions reveal a familiarity with the actual methods on the part of the authors which inspires confidence.

The book contains a large amount of material, well arranged and with useful cross-references. Qualitative analysis of the common metals and acid radicals and rare metals, preparation of solutions, sampling, selected methods for the quantitative analysis of the elements (arranged in alphabetical order with bibliographies), analysis of commercial metals, non-ferrous alloys, iron and steel and ferro-alloys, ores, slags, metallurgical products (drosses, ashes, scrap, and so on), including assaying, refractory materials, and coal, are all dealt with in a very practical manner, and the chemist who follows the clear directions of the authors may hope to carry out the operations with success. The book is well printed and provided with a good index. It should commend itself to a large number of chemists.

J. R. P.

Chemistry of Sulphur and Selenium.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By Dr. J. W. Mellor. Vol. 10: *S, Se.* Pp. x+958. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 63*s.* net.

IT is more difficult to write an adequate review of the tenth volume of Mellor's "Comprehensive Treatise" than it was to review the earlier volumes, since the author's methods of presentation have long since become standardised and are now quite well known. Indeed, an intelligent reader might hope to predict the general characteristics of the volume on sulphur and selenium by studying those on the related elements, in the same way that Mendeléeff predicted the properties of *eka-* and *dwi-*manganese from those of contiguous elements in his Periodic Classification. From this point of view, the new volume is 'true to type' and presents no marked contrasts with those which have preceded it. An inspection of the paragraphs dealing with subjects with which the reviewer is most familiar compels him, however, to pay a tribute of admiration to the almost uncanny way in which even the most obscure researches have been included in the author's survey.

The volume on sulphur and selenium includes many interesting topics, perhaps because sulphur shows some tendency to mimic carbon by forming chains of atoms, leading to the formation of hydrides, chlorides, and oxy-acids containing several atoms of sulphur. Both sulphur and selenium also present interesting phenomena of allotropy. Subjects such as these, as well as the vast range of data that have resulted from the intensive study of compounds such as sulphur dioxide and sulphuric acid, are adequately covered in the new volume. On the other hand, it is difficult to discover any reference to the 'parachor', since references to molecular volume and surface tension are not followed by data for this derived function. The retention of formulæ which represent sulphur and oxygen as being joined by a non-polar double bond follows naturally from this point of view, but is definitely misleading in view of the evidence provided by Sugden and by Phillips that this link is semi-polar—a rule to which no exception has yet been found. The formulæ thus retained are historically correct, but create a 'pre-War' atmosphere, which is not justified by the up-to-date character of the text.

Dr. Mellor is to be congratulated on the progress which he has made, since he has now covered nearly all the elements except those which occupy the eighth column of Mendeléeff's table. These interesting and important elements will, however, probably call for two, if not three, additional volumes, before the task which the author has set himself can be finished. Even at this late stage, it may perhaps be useful to suggest that the page headings might be employed to indicate the contents of the sections into which each chapter is divided, instead of repeating the name of the element at the head of each page—for example, more than 300 times in the case of sulphur.

T. M. L.

Our Bookshelf.

Anthropology and Archæology.

(1) *The Circle and the Cross: a Study in Continuity.* By A. Hadrian Allcroft. In 2 volumes. Vol. 2: *The Cross.* Pp. vii+454+4 plates. (London: Macmillan and Co., Ltd., 1930.) 12*s.* 6*d.* net.

(2) *The English Parish Church.* By A. R. Powys. (The English Heritage Series.) Pp. xix+165. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 3*s.* 6*d.* net.

(1) In the first volume of this work, which was published separately, the author made a study of the tradition of the pagan circle. In the second, which appears after his death, he has turned to the cross, the early Christian church in Britain and Ireland, and traces its relation to the antecedent circle. His thesis is that paganism and Christianity, both being cults of the dead, the converts to the new faith continued to worship at the old holy places, the mounds and burial-places of the dead, which became the site of the Christian church, and to use them as the place of interment and of assembly for the discussion of the affairs of the community and for games, feasts, and fairs. On a review of the evidence, the author makes out a strong case for carrying this continuity much further in detail than has been done before. The identity of the places of worship of Christianity and paganism has been frequently argued; it is supported by the letter of instruction from the Pope to Mellitus permitting the use of pagan shrines for Christian worship, even if other evidence did not point in the same direction. Mr. Allcroft has greatly extended the field in which continuity of practice and belief must be allowed. On certain points, however, he has pressed his theories rather far, as he himself would have been the first to admit. His assumption of a widespread Celtic influence in the area of the Saxon church solves many of his problems, but it would be hard to prove.

(2) In "The English Parish Church" Mr. Powys has given an account of the church as an institution in the rural life of the past, for the benefit of overseas visitors and those of our own public whose interest has been aroused by the efforts now being made to preserve any relics of an earlier day. Unlike Mr. Allcroft, he holds to the manorial origin of the parish church, and makes the early Saxon church his starting-point. His chapter on the secular uses of the church building may profitably be compared with the treatment of the same subject in Mr. Allcroft's book.

A Book of the Basques. By Rodney Gallop. Pp. xii+294+16 plates. (London: Macmillan and Co., Ltd., 1930.) 15*s.* net.

Mr. Gallop views the Basque with the eye of a realist. He heartily condemns imaginative attempts, on insufficient acquaintance, to portray him as a romantic relic of a vanishing race. Instead, he finds him a reserved, unimaginative individual, with a strong sense of humour and a pronounced bias towards independence, very markedly shown in his attitude towards his Spanish neighbours in past history. While it is true that the Basque is vanishing, it is not the race but the culture that is disappearing. A vigorous commercial and industrial activity carries with it development on lines that are purely Spanish. It is remarkable that this energy shown by the Basques on the south side of the Pyrenees is not to be found among the French Basques.

Mr. Gallop does not profess to solve the philological and ethnological problems of the race. For the benefit of his readers, he summarises the theories which have been put forward, just as he describes the country and some of the salient events in Basque history, in order to provide a background for and an insight into Basque character. His main interest is the primitive culture of the people, and particularly their songs, plays, music, dances, legends and superstitious beliefs. All these he describes in considerable detail and analyses with penetrative insight. These chapters of Mr. Gallop's book will repay detailed examination. It is evident that the Basque has a great power of assimilation as well as of improvisation. The result is that, while borrowing from outside sources (the origin of some of the folk-music is to be recognised at once as some popular air from another country), the element borrowed has been moulded to conform to a perfectly definite racial type. On the other hand, the folk-dances present many features of a very primitive character, which Mr. Gallop, without doubt rightly, ascribes to a primitive spring ritual.

The Bronze Age. By Prof. V. Gordon Childe. Pp. xii+258. (Cambridge: At the University Press, 1930.) 8*s.* 6*d.* net.

Prof. Childe's book on the Bronze Age is modest in appearance; but that is no criterion of its merit. He has given his readers what might well be termed a complete handbook of the period, having in view the needs of the beginner and that useful person, the general reader. He takes up the story of prehistory where it was left by Mr. M. C. Burkitt in "Our Early Ancestors", and begins with the discovery by early man that certain kinds of stone are susceptible to treatment by heat—the discovery of metal working. From this germ he traces the development of Bronze Age culture, highly elaborated in technology and art and relatively advanced in its system of commercial and international communication.

The general sketch of cultural conditions is followed by a section on the typology of the Bronze Age, in which the various classes of objects of material culture are passed in review and the development of each within the period is followed up. Finally, the history of cultural groups and cultural movements is traced in so far as this may be deduced from the material provided by archæological discovery.

It is scarcely necessary to say that Prof. Childe's treatment of his subject matter is thorough and individual. His unrivalled knowledge of the archæology of the Danubian area enables him to speak with authority on the obscure racial or, as he would prefer to put it, cultural group movements at the beginning of his period. He has an interesting if not very conclusive chapter on the races of the Bronze Age; but his most interesting point is his conviction of the persistence of Bronze Age peoples through later periods. It is more than probable that he is correct; but he is no less apt in pointing out that in Britain, at any rate, much research is necessary before a definite conclusion can be reached. Especially is this true of the bearing of folklore on the question.

Decorative Patterns of the Ancient World. By Sir Flinders Petrie. Pp. 17+88 plates. (London: British School of Archæology in Egypt; Bernard Quaritch, Ltd., 1930.)

THIS volume is intended to serve as the first outline of an index to "all the decorative imaginings of mankind", an undertaking indeed of no little magnitude. Here, however, certain limitations are observed. Much sufficiently known already is avoided; the time-series limit is set at A.D. 1000; the examples are drawn only from Europe and western Asia (especially Egypt, Mesopotamia, and the Mediterranean), with their links in other lands. Sir Flinders Petrie here touches again on the value of decorative design as presumptive evidence of connexion between the designers, where historic connexion between the designs can be traced, on the ground that purely decorative design has no stimulus of pressure towards use or invention such as that which underlies an essential obviously needed. This principle is illustrated often when designs are brought together, as they are here, arranged under their classes. Among them, perhaps the most striking example is that with which the series opens, a central figure with an attendant pair of lions, wolves, or other animals, one on either side. This is one of the earliest motives of Egypt and Mesopotamia which persists through the ages down to the present day, when it appears as the lion and the unicorn of the Royal Arms and in the supporters of armorial coats.

Biology.

An Introduction to Vertebrate Embryology. By Prof. H. L. Wieman. (McGraw-Hill Publications in the Zoölogical Sciences.) Pp. xi+411. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 20*s.* net.

THERE can be no doubt that the easiest approach to the study of vertebrate anatomy is the development of the embryo and its organogeny. In recent years, in American colleges and universities, there has been a tendency to relegate certain of the initial subjects of the crowded medical curriculum to the two pre-medical years of study, and to combine the teaching of embryology with comparative anatomy and histology. Thus a wider and more generalised field can be covered than is permissible in human embryology alone. In the book under review, considerable space has been devoted to questions of general development, cytology, and the early development of *Amphioxus* and the frog. Reference is made to some of the more recent work of Spemann, Mangold, and Marx on 'organisms' or embryo-forming materials.

As regards the remainder, the treatment of the development of the chick, pig, and man follows conventional lines and draws for its inspiration upon Lillie's "Development of the Chick" and the "Contributions to Embryology" of the Carnegie Institution of Washington. Throughout, it has been the aim of the author to direct attention to the experimental aspects of the subject, and to make the descriptive material of the book complement the work in the laboratory, for which a manual has been prepared and published separately.

The illustrations are not all that might be desired. In the case of those of the development of the human venous system (Figs. 161-163) the differentiation of the components is not made sufficiently clear to aid the student in understanding what is a rather complicated series of steps. It is doubtful, too, whether the substitution of "sudoriparous" for "sudorific" as applied to the human sweat glands is an improvement in terminology.

Histological and Illustrative Methods for Entomologists. By Dr. H. Eltringham. With a Chapter on Mounting Whole Insects, by H. Britten. Pp. xi+139. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 7*s.* 6*d.* net.

IN the space of 140 pages, Dr. Eltringham has been successful in furnishing a concise yet lucid account of the standard methods employed in the study of the anatomy and histology of insects. The initial chapters of the book are devoted to a description of the apparatus and materials required for the cutting and staining of sections. There is a useful chapter on the dissection and preparation of the genitalia, the characters of which are now extensively used by systematists for the differentiation of species. Of not the least importance is the chapter on the mounting of small entire insects, contributed by Mr. H. Britten, who recommends a method which is at once simple, effective, and time-saving.

Every biologist recognises that good illustration is the handmaiden of morphology, and the entomologist with a bias towards anatomy will be encouraged to learn that there are several mechanical aids that can be used in preparing drawings of his subjects that render the lack of a natural artistic ability a matter of minor importance. In teaching structural complexities of individual insect parts, models have a decided value, and the author has shown how simple models can be prepared at very little cost. Useful hints on the colouring of lantern slides and photographs are also supplied for the benefit of those who are called upon to lecture on entomological topics.

Although it was the admitted intention of the author to cater for the needs of the amateur entomologist with no laboratory training, the book will also prove a useful guide to those who have adopted entomology as a profession. A. E. C.

Couleurs et pigments des êtres vivants. Par Dr. Jean Verne. (Collection Armand Colin : Section de biologie, No. 123.) Pp. 219. (Paris : Armand Colin, 1930.) 10·50 francs.

At every turn the students of natural history and of biology are compelled to consider the colorations of animals, and the first essential is to know what are the physical and chemical characters of the pigments with which they have to deal—and, if possible, how they are produced. Some pigments are excretory, others for respiration, others for nutrition, and others to fix energy (chlorophyll). Living matter has a colour of its own and there are pigments in the blood and other internal tissues, in special pigment cells, usually provided with pseudopodia, and in the exoskeletons of animals. Plants have chlorophyll and the colours in fruits are especially interesting. Then there are colours due to reflection, to refraction, and to light decomposition. Lastly, an animal may be coloured by its food. The discussion from the point of view of protective coloration is very short, but it is unnecessary, since the facts relating to all types of colour are given succinctly so that the student may judge for himself. We recommend this as a book useful to and within the means of every biologist. It has an excellent bibliography.

Chemistry.

Recent Advances in Physical and Inorganic Chemistry. By Prof. Alfred W. Stewart. Sixth edition. Pp. xi + 387 + 5 plates. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1930.) 18*s.* net.

The new edition of Prof. Stewart's "Recent Advances" provides striking evidence of the rapidity with which fundamental facts and theories of physical and inorganic chemistry have developed, since there is scarcely a single topic in the whole volume which could have been foreseen when the first edition of the book was issued. Thus, the foreground of the picture is now occupied by line spectra and X-ray spectra, and the background by band spectra and Tesla-luminescence spectra ; whilst the centre is devoted mainly to radioactivity, positive rays, and other aspects of the problem of atomic structure. Amongst these chapters on atomic physics, there are interpolated a few of a more chemical character, dealing with newly discovered elements, with various forms of active hydrogen, and with some new hydrides. This gives to the book the character of a very modern inorganic chemistry, but the inclusion of physical chemistry in the title is definitely misleading, since there is no reference of any kind to recent advances in this field (as it is commonly defined), with the exception of a belated chapter on "The Donnan Equilibrium", which might have appeared in an earlier edition of the book, but is now wedged uncomfortably between chapters on "The Periodic System" and "Some Flame Reactions".

Whilst, therefore, Prof. Stewart has provided an up-to-date report on atomic physics and related topics, it would be a *reductio ad absurdum* to pretend that a book in which dipole moments and strong electrolytes are not mentioned can serve as a guide to the very real advances which have been made in physical chemistry since the War. It should, however, be made clear that it is the title of the book that is at fault, and not the contents, since these are full of interest and contain many valuable references to work which is only beginning to find a place in the systematic text-books of inorganic chemistry.

The Study of Crystals : a General Introduction. By T. V. Barker. Pp. xvi + 137. (London : Thomas Murby and Co., 1930.) 8*s.* 6*d.* net.

It is greatly to be hoped that science teachers will respond generously to Dr. Barker's efforts to mitigate the ill-effects of specialisation in science. The subdivision of natural science into several branches, while unavoidable in consequence of the extension of scientific knowledge, is unfortunate. The teacher should endeavour to treat science as a unit so far as possible, that his pupils' knowledge may be built on the broadest possible foundations. But when it comes to the study of crystalline matter, he is chary of handling a subject he has never been taught. Dr. Barker's book should assist him greatly, indicating how a study of crystals may readily be incorporated into the usual courses in chemistry and physics. Moreover, benefit will be felt in the teaching of solubility and other phase-rule relations, heat and light, and the concept of isomorphism and polymorphism and the like.

Of the value of such a course to the pupil, no one can doubt who has met the numerous examples in physical chemistry where the slightest experience in the study of crystals under the microscope would have avoided grave error. To those workers who have not had the benefit of such experience or instruction, the book may be cordially recommended ; it should help to dispel the illusion that crystallography is essentially and necessarily a matter of difficult trigonometry and of no practical value. M. H. H.

A Text-book of Organic Chemistry. By Dr. A. F. Holleman. Seventh English edition, completely revised with the co-operation of the Author. Pp. xx + 594. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1930.) 17*s.* 6*d.* net.

The great success of Prof. Holleman's text-book, of which thirty-seven thousand copies have been issued in all and in nine languages, is certainly in part due to the point of view which the author expresses in the preface to the present edition. "So long as there is a public to buy it," he says, "a novel can be reprinted unchanged ; but even with an interval of only a few years between successive issues, each new edition of a text-book

of chemistry needs not only careful revision, but also the rewriting of some of its chapters." Prof. Holleman has taken into account the recent advances in the subject, including the constitution of the dioses, enzymes, and particularly the applications of physical chemistry to organic chemistry—a feature which has always been noteworthy in previous editions. More attention is given to fundamentals than in most text-books, and in its present form the book is by far the best treatise for students which is available. Its use will make the subject interesting and provide a stimulus for further study.

The Structure of Silicates. By Prof. W. L. Bragg. Pp. 69. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 5 gold marks.

It is unnecessary to insist on the significance of this monograph from the point of view of the crystallographer. Under its somewhat uninviting title it does, however, also include much of interest to the chemist, the points of similarity and dissimilarity between the silicon-oxygen complexes which are of such importance in the inorganic world and the carbon chains and rings of organic compounds appearing clearly. Other matters of importance which are dealt with are the correct formulæ for silicates—the atomic components should be expressed on the basis of a constant number of oxygen atoms characteristic of the type of structure—and Pauling's ideas upon valence, with the not dissimilar rules for the build of structures which have been developed by W. L. Bragg and Goldschmidt. One feels after reading this book that it was a hopeless task to attempt to unravel crystal structure without the help afforded by X-rays, but that now full description of all crystals is likely to be accomplished in the not remote future.

Engineering.

Johnson's Materials of Construction. Rewritten by Prof. M. O. Withey and James Aston. Edited by F. E. Turneaure. Seventh edition. Pp. xxii+859. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 30*s.* net.

The application of scientific discoveries to engineering practice generally only becomes possible when new technique and new materials have been developed which make possible the application. During the last century great advances have been made in engineering, and the success achieved has in no small measure been dependent upon the finding of new materials, developments of accurate methods of testing the properties of materials under ordinary and high temperatures under static and repeated stresses, and how these properties are affected by heat treatments and manufacturing conditions. Further, the materials that are used in the largest quantities in modern engineering are irons and steels, which are subject to rapid corrosion in many atmospheric conditions, and thus where possible such metals, as well as the timbers, have to be protected by suitable coverings.

The volume before us, after a preliminary study of the mechanics of materials, describes the machines and apparatus required for the carrying out of the many types of tests used in modern engineering practice, and then proceeds to deal with various types of structural materials in detail. Timbers, cements, concrete, building stones, structural clays, ferrous and non-ferrous alloys are discussed. Constitutional diagrams are given of the copper-zinc and copper-tin alloys, and interesting chapters are devoted to the effect of heat treatments and the form on the properties of metals. Clearly drawn diagrams illustrating these properties, and excellent photomicrographs showing the structure of metals produced by various treatments, are given. Chapters are devoted to the preservation of timbers and the corrosion of metals.

The book is excellently printed, the diagrams are clear, and the work should prove of great service to engineering students as well as to those in practice.

Hydraulics: for Engineers and Engineering Students. By Prof. F. C. Lea. Fifth edition. Pp. xii+775. (London: Edward Arnold and Co., 1930.) 21*s.* net.

In the course of twenty-two years, since its first appearance, Prof. Lea's work has passed through five editions, with intermediate reprints—a fact which eloquently speaks for the popularity and acceptability of the volume to students of the subject. It has grown considerably in bulk since the present writer reviewed it in Nature in 1908, and now numbers nearly 800 pages. Designed to cover the vast field of engineering practice comprised in the modern science of hydraulics, the expansion is scarcely to be wondered at; and, indeed, in turning over the leaves, one does not find that there is any inclusion of inappropriate material or pleonasm of treatment.

Nearly a fifth of the volume is devoted to a consideration of turbine and water-wheel problems, and another important section of 130 pages is absorbed in a consideration of the subject of centrifugal and reciprocating pumps. While the subject as a whole is treated comprehensively and as analytically as one might reasonably expect in a volume which aims at serving the needs of students, it is possible, of course, to point to some matters in which there is room for inclusion of material. The treatment of flow in pipes and channels is full, but there is no mention to be found of Dr. Herbert Chatley's researches in connexion with the Whangpoo and Yangtse rivers, or more than a meagre reference to the striking conclusions in Barnes' "Hydraulic Flow Reviewed", which the present writer came across on a first perusal, but failed to trace afterwards by means of the index. Indeed, the index is a little defective on several points.

These, however, are minor details. Taking it as a whole, Prof. Lea's work is a substantial and serviceable contribution to the literature on hydraulics, and, as heretofore, will be found an extremely useful guide to the practitioner, as well

as to the student. The book is admirably produced and the diagrams are clear and distinct.

The Elementary Principles of Wireless Telegraphy and Telephony. By R. D. Bangay. Third edition, revised by O. F. Brown. Pp. xii + 268. (London: Iliffe and Sons, Ltd., 1930.) 10*s.* 6*d.* net.

To anyone desiring instruction in the principles underlying the working of modern radio apparatus this work can be recommended. It is necessary to have a working knowledge of electricity and magnetism and the principles of wave motion. This is given first, and then we have chapters on aerials, receivers, masts, thermionic valves, and triodes — their use as amplifiers being explained. There is a good chapter on the frequency stabilisation of transmitters, descriptions being given both of control by tuning-forks and by quartz oscillators. The design of a modern broadcast radio receiver is fairly fully described, and also the use of a.c. and d.c. eliminators.

Stress is laid on the danger of amateurs using home-made all-electric sets which are connected directly with the public electric supply mains. There is always a risk that sooner or later one of the outers of the public supply mains may make contact with earth, thus raising the potential of the middle main to 200 volts or more. In this case there is a real risk from shock, and the fire risk is also serious. The Institution of Electrical Engineers publishes regulations showing how these risks can be obviated. There is a chapter on radio direction-finding which gives in little space a description of the Bellini-Tosi and the Robinson systems. The final chapter discusses the propagation of waves and the causes and effects of atmospherics. The lower ionised region of the atmosphere produces little attenuation on very short waves, and hence short waves which suffer multiple reflections between the ionised layer and the earth frequently travel better by day than by night. No method of eliminating entirely the effects produced by atmospherics has yet been found.

Alternating Current Electrical Engineering. By W. Tolmé Maccall. Second edition. Pp. viii + 496. (London: University Tutorial Press, Ltd., 1930.) 15*s.*

This book can be recommended to students reading for the B.Sc. examinations of the University of London. It gives the necessary groundwork for the electrical technology required in the examination. Very little knowledge of the calculus is required, and the author's aim has been to make the theoretical part of the subject easily intelligible to the average student. This naturally prevents him discussing many of the difficulties that arise. He gives, however, a fair number of references to advanced books and papers. We were pleased to notice that he has brought the nomenclature into line with the British Standard Glossary (published by the B.E.S.A.). The word 'capacitance' instead of 'capacity' (electrostatic) seems now to be generally adopted.

The chapter on harmonic analysis is rather brief. No clear distinction is drawn between the Fourier analysis and the Lagrange method of interpolation. Perry's method is an example of the former and Runge's method of the latter. We think the best and most accurate way of analysing a wave is to apply the modern formulæ for mechanical quadrature to the Fourier integrals. It is pointed out that various authors following the interpolation method of Runge have given 'schedules' to facilitate the calculations when the harmonics have to be calculated to the eleventh or beyond. One authority quoted divides the half-period into 26 ordinates and then gives a schedule for getting the first 25 harmonics inclusive. It seems to us that this would be a waste of labour. The values of the harmonics above the ninth obtained in this way would probably be inaccurate, unless it so happened that no harmonics greater than the twenty-fifth were present.

Easy Lessons in Television. By Robert W. Hutchinson. Pp. vii + 175. (London: University Tutorial Press, Ltd., 1930.) 1*s.* 9*d.*

It seems fairly certain that television will have a great future, but, like all inventions, it is difficult to predict when it will become commercially successful. Of the systems in use, that invented by Baird seems to have made the greatest progress, and this little book gives an excellent description of it in non-technical language. Perhaps too much stress is laid in the opening chapter on the atomic nature of electricity. It is not very instructive to quote numbers beyond our comprehension. A clear description is given of the photoelectric cell, which enables a varying light scattered by the object to be 'televised' into a varying current of electricity. The varying currents can then be changed by a neon lamp to a fluctuating light which can be received on a screen; for television, neon is found to be the best gas to use, as it responds instantaneously to changes in the current.

The thermionic valve and the radio receiving set are described, and the book finishes with a description of the televising of a silent film (called telecinematography), television in the theatre, and telephotography. The Siemens system is used by the Post Office for transmitting pictures to Germany and Denmark, the Belin system is largely used in France, and the Bell system in the United States.

Modern Bridge Construction: a Treatise setting forth the Elements of Bridge Design and illustrating Modern Methods of Construction. By F. Johnstone Taylor. Pp. xii + 235. (London: Crosby Lockwood and Son, 1930.) 15*s.* net.

A short treatise on any branch of engineering may serve as an introduction to the subject, as a handy book of reference, or as a guide to the latest practice. The book under notice may well do all these. In twelve chapters the author deals in turn with masonry bridges, small steel bridges, trussed girders, girder-bridge construction, steel bridges, constructional details, steel-arch bridges, swing bridges, lifting bridges, erection methods,

ferro-concrete bridges, and suspension bridges. The aim of the book in the first place is to meet the needs of the average civil engineer, who requires some knowledge of bridge design, and of the examination candidate. It covers the ground in a plain, straightforward manner. The use of higher mathematics has been avoided so far as possible, the diagrams are clear, and there are numerous references to recent bridge construction as described in the *Engineer*, *Engineering*, and other journals.

Geography.

Cornwall: a Survey of its Coast, Moors and Valleys, with Suggestions for the Preservation of Amenities. Prepared by W. Harding Thompson for the Cornwall Branch of the Council for the Preservation of Rural England. With Notes on the Antiquities of Cornwall, by Charles Henderson. Pp. xix + 130 + 42 plates. (London: University of London Press, Ltd., 1930.) 17*s.* 6*d.* net.

ANOTHER handsome, well-illustrated quarto has been added to the library dealing with the preservation of English landscape. The suggestions of most general importance are those relating to the coast. Support is given (so far as concerns Cornwall) to the proposals which have been made to the National Park Committee, that in Cornwall and the opposite peninsula of Pembrokeshire the National Coast Parks of Britain should be situate. In the opinion of the authors of the Cornwall survey, "The formation of a National Coastal Park would afford lasting benefit to visitors from urban centres, and incidentally it would benefit a county suffering from acute industrial depression".

The frontages for coastal parks, shown in a special map, are nearly the same as those suggested in my evidence to the National Park Committee and my book upon the subject; but the authors of the present survey have improved upon those suggestions in one important particular, namely, by extending farther inland the proposed coast park on the west of St. Ives, so as to include the district of prehistoric monuments which here, as in the Pembrokeshire promontories, add greatly to the romantic interest of the scene. The recommendation also that steps should be taken "with a view to keeping open a public footpath all round the coasts of Cornwall" is welcome. This is, indeed, a matter which should engage the immediate attention of local authorities in every maritime county.

VAUGHAN CORNISH.

Grundzüge der Physiogeographie. Mit Benutzung von W. M. Davis *Physical Geography* und der deutschen Ausgaben; zum Gebrauch beim Studium und auf Exkursionen. Neu bearbeitet von Prof. Dr. Gustav Braun. Band 1: *Spezielle Physiogeographie.* Pp. xii + 178. 8 gold marks. Band 2: *Allgemeine vergleichende Physiogeographie.* Dritte Auflage. Pp. xii + 256. 10 gold marks. (Leipzig und Berlin: B. G. Teubner, 1930.)

PROF. BRAUN has based this small text-book of physical geography on the well-known volume of Prof. W. M. Davis which first appeared in 1889 and afterwards was translated into German. The work has undergone thorough revision, which entailed rewriting several of the sections, including those on weather and climate. It covers the whole groundwork of the subject, including the distribution of vegetation. Some of the original illustrations remain, but many are new or derived from various sources, and their excellence is one of the best features of the book. Particular attention has been paid to reference to original sources and each section has copious reference to books and papers. A glossary of English and German technical terms is a useful addition. The book should prove of great value to students, and fully equals any work of the same standard now available in English.

Death Valley: the Facts. By W. A. Chalfant. Pp. ix + 155 + 16 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1930.) 16*s.* net.

Grand Canyon Country. By M. R. Tillotson and Frank J. Taylor. Pp. viii + 108 + 15 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1929.) 9*s.* net.

THESE two small and beautifully produced volumes, although they bear no indication of belonging to any series, have considerable resemblance in their point of view and scope. Neither deals with new material nor is in the nature of a personal narrative, but both give useful summaries of facts of history and physical conditions. They are, in short, handbooks of scientific information. The volume on the Death Valley is the fullest and contains useful chapters on plant and animal life, in addition to sections on physical geography and geology. Each volume has some well-chosen photographic illustrations and a 'cartograph' or pictorial map printed on the end papers. That of the Grand Canyon country is so full of whimsical pictures scattered over the map that a popular use of the volume is suggested. The Death Valley map has no flights in imagination.

Geology.

Geochemie in ausgewählten Kapiteln. Von W. J. Vernadsky. Autorisierte Übersetzung aus dem Russischen von Dr. E. Kordes. Pp. xii + 370. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 25 gold marks.

CLARKE'S invaluable "Data of Geochemistry" is justly so highly esteemed, especially in English-speaking countries, that there has been a natural tendency to regard it not only as an indispensable compilation of data but also as a standard exposition of geochemistry itself. Only recently has this tendency been checked by growing acquaintance with the brilliant work of Fersman, Vernadsky, and Goldschmidt. A most useful and illuminating little book was published in French by Vernadsky in 1924 under the title "La Géochimie". In 1927 a revised translation appeared in Russian, and now a third and greatly enlarged

edition has become available, this time in German. After an historical introduction, the mode of occurrence of the chemical elements in the earth's crust is passed in review, with special reference to their concentrated or dispersed distribution in the successive earth-shells, including that of the biosphere. The succeeding chapters deal in great detail with the geochemistry of manganese; with silicon and silicate minerals, including the parts played by compounds of aluminium and iron and the significance of the colloidal state; with the carbon cycle and the geochemical activities of living organisms; and finally with the distribution of the radioactive elements and their relation to lead and helium and the earth's thermal history. The book concludes with an excellent annotated bibliography and indexes of authors and subjects.

The author is to be congratulated on a work of fascinating interest, imbued throughout with the spirit of research, and touching everywhere on points of great importance to geology and chemistry that are generally passed over in more formal text-books. As three other languages have already had their turn, we may perhaps be allowed to express the hope that when the fourth edition is prepared it may be published in English. Its welcome is already assured.

American Mesozoic Mammalia. By George Gaylord Simpson. (*Memoirs of the Peabody Museum of Yale University*, Vol. 3, Part 1.) (Published on the Othniel Charles Marsh Publication Fund.) Pp. xv + 235 (32 plates). (New Haven: Yale University Press; London: Oxford University Press, 1929.) 5 dollars.

THIS work forms a companion volume to the same author's monograph on the European Mesozoic mammals which was published in 1928 as a catalogue by the Trustees of the British Museum. In the present volume the author has rounded off his investigations by a description of the pre-Tertiary mammals of the American continent. While there are here no faunas at present known quite so early as the Rhætic and Middle Jurassic of the Old World, there are, on the other hand, at least a few places where Cretaceous mammal remains occur. A knowledge of what happened in this period is so essential to our understanding of the evolution of placental and marsupial lines, and the localities and their yield of specimens so scarce that the dozen genera of marsupials and three of placentals here catalogued by Dr. Simpson acquire considerable importance.

A large part of the general description of the six Mesozoic orders of mammals has already been given in the British Museum Catalogue, where also questions as to their reptilian origin and their inter-relationships are fully discussed. To this every reader of the present memoir will have to refer. The two works with their excellent plates and figures, and the sound and workmanlike treatment of the subject, form an admirable and useful treatise.

Limestones: their Origins, Distribution and Uses. By Dr. F. J. North. Pp. xxiii + 467. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1930.) 16*s.* net.

FEW people realise the importance of the part played by limestone in the economic life of the nation. It enters into nearly every phase of human industry, and on its varied uses Dr. North has written a most interesting and readable book. No aspect of the subject appears to have escaped his attention; he deals with the origin of limestones and their distribution in the various geological formations in such a manner as to make the book an excellent introduction to the science of geology, and it may be recommended confidently to the general reader who desires to know something of the history of the earth. The book is profusely illustrated, and to each chapter is appended a list of references which form a useful bibliography of the subject.

As evidence of the care taken by the author, the book is remarkably free from errors. One, however, may be pointed out. On page 242 it is stated that the lower part of the Speeton Clay "is of Jurassic age (corresponding to Portland and Purbeck Beds)". A similar mistake is to be found on page 185. There are no marine representatives of the Portland and Purbeck rocks in Yorkshire; the beds referred to by Dr. North are now placed in the Lower Cretaceous.

Mathematics.

Theory of Functionals and of Integral and Integro-Differential Equations. By Prof. Vito Volterra. Edited by Prof. Luigi Fantappiè. Authorised translation by Miss M. Long. Pp. xiv + 226. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 25*s.* net.

THIS translation of lectures, delivered in 1925 before the University of Madrid and since corrected and improved by the author, gives a concise survey of 'functionals', first studied by him in 1887 under the name of "functions depending on other functions", and later called "functions of lines". The first chapter gives definitions, properties of functionals, and operations performed on them. The second chapter treats of problems of the functional calculus and in particular of integral equations. Then follows a chapter on the extension of the concept 'analytic function' to functionals and, more particularly, extensions of the Riemann and Cauchy theories of conjugate functions in the xy plane to conjugate functions in space. The fourth chapter treats of the composition and permutability of functions, and leads to an extension of the concept 'power-series of a variable' to functionals. The fifth chapter deals with integro-differential equations and functional derivative equations and their relations to the Hamilton-Jacobi theory, the new quantum electro-dynamics, and Green's functions. The last chapter gives a summary of the applications of functionals to a variety of topics; in order to give some idea of the wide range of the subject matter of the lectures we

may mention the calculus of variations, oscillations of lakes and membranes, and hereditary problems in dynamics, elasticity, and electromagnetism.

As the treatment is very concise, and detailed proofs are rare, the book is difficult to read; but full bibliographies appended to the various chapters, frequent references in the text, and an excellent translation will no doubt prove of great assistance to the reader. No one interested in the topics dealt with can afford to ignore this work by one of the most prominent Italian mathematicians.

Vectorial Mechanics. By Prof. Louis Brand. Pp. xvii + 544. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 25*s.* net.

THE book before us is intended as "an introductory text-book on mechanics for students of engineering and physics". It fulfils the first of these functions perfectly, in so far as it includes a great number of problems and worked examples chosen from topics of special interest to engineers. Physicists, however, are not so well catered for, and unfortunately some of the fundamental principles are not given in a form sufficiently general for the purposes of modern physics. Thus, Newton's Second Law is stated only for invariable masses, and the Third Law only for central forces, no provision being made for extensions to relativity problems and to electromagnetic systems.

These are but slight blemishes on an otherwise excellent book which should prove of great use to engineering students. Vector methods are used freely and are sufficiently explained in two chapters on vector algebra and vector calculus. A chapter is devoted to three-dimensional statics, and it includes an elegant method of reducing the general system of forces, first to two forces and then to a force and couple. There is a long chapter on the kinematics of plane motion with applications to linkages and various gears, and another on the dynamics of rigid bodies with applications to the balancing of masses, to governors of various types, and to the gyroscope as used in engineering. Although intended primarily for students in American universities, it will no doubt be of interest also to English students and teachers.

Topology. By Prof. Solomon Lefschetz. (American Mathematical Society Colloquium Publications, Vol. 12.) Pp. ix + 410. (New York: American Mathematical Society; Berlin: Hirschwaldsche Buchhandlung; Cambridge: Bowes and Bowes, 1930.) 4.50 dollars.

THE monograph under review illustrates in a striking way the great progress made in mathematics in recent years even in so specialised a branch as *Analysis Situs*, for the bibliography includes nearly three hundred references, almost all to papers published during the last decade. The work is not a text-book, but, as it were, a digest of research work done in the subject since the publication of Veblen's "Analysis Situs" in 1922. Consequently, it makes great demands on the reader's knowledge, and is not suitable as an introduction to the subject; but it is of great importance to the expert in topology, and will prove to be a mine of information for all engaged in research in this field.

The topics treated are the elementary combinatorial theory of complexes, the topological invariance of the homology characters, manifolds and their duality theorems, chains on a manifold, product complexes, transformation of manifolds and infinite complexes, with applications to analysis and algebraic geometry. The book is well arranged and clearly written, as may be expected from one who, like the author, has distinguished himself by research in the subject, and appears likely to exert a beneficial influence on future research.

Miscellany.

George Eastman. By Carl W. Ackerman. Pp. xviii + 522 + 25 plates. (London: Constable and Co., Ltd., 1930.) 24*s.* net.

GEORGE EASTMAN is a man of great faith, enormous energy, and indomitable perseverance. He left school at fourteen years of age (1868) and worked in an assurance agency, and a year later he became practically interested in photography. In 1877, after he had been working hard making emulsions and a coating machine, often all night, for he was still engaged as a clerk during the day, he determined to make plates commercially, and in 1879 he patented his coating machine, and in 1880 he was in business for himself. In 1884 he got the notion of a transparent film, and was obsessed with its advantages; and in the same year, in conjunction with Mr. Walker, he patented the roll holder. These were the beginnings of the Eastman Kodak Company.

The company has not always sailed in smooth waters—far from it; but when his partners were pessimistic, when some of his employees conspired against him, when the Government took action against him because of the vastness of his business, and when in early times the company was in debt, Mr. Eastman was always optimistic. He wrote: "The manifest destiny of the Eastman Kodak Company is to be the largest manufacturer of photographic materials in the world, or else to go to pot", and he took good care to realise the former alternative. He also wrote: "I am a believer in one man management and that a Board of Directors is valuable only as an advisory instrument to a good manager". He believed in full-page advertisements and many of them. In the year 1896 he made his one hundred thousandth kodak, and at the factories at Rochester (N.Y.) and Harrow was making about one hundred miles a week of film and photographic paper. Mr. Eastman has been a great and generally anonymous helper of the needy all his life, increasing his gifts as he was able until they reached millions of dollars.

The author has used the enormous mass of documents at his disposal with much skill in writing the fourteen chapters, or essays, of which the book consists, and has appended a very full and useful index.

The Indexing of Books and Periodicals. By Dr. John W. T. Walsh. Pp. 118. (London: Edward Arnold and Co., 1930.) 6*s.* net.

It cannot yet be said that the good index is the general rule, whether for books or for periodical literature, and no reader of Nature will regard a new book on the subject as superfluous. Dr. Walsh's book does not deal with main theoretical principles, and contains little that is new for actual practice; but the main features that make for good indexing cannot be repeated too often, and they are here, on the whole, set out with due emphasis.

Dr. Walsh is, however, not always clear in his directions. For example, an alphabetical series such as "Cat, Domestic—Catfish—Catgut—Cat skins" is characterised as most undesirable on one page, but appears to be justified by the rule given on the next. And why does Dr. Walsh say that the most suitable form of index for 'abstract' journals is the classified form, with a reference to the Brussels decimal scheme? It is not easy to see why this type of journal should be placed for this purpose in a class by itself, and why the alphabetical arrangement should here be discarded. It may be advisable for the abstracts themselves to be arranged in class order, for they are designed to be used at the moment of publication as a survey of the current literature of their subject. But for the annual index, which is only as a rule a finding tool for some specific feature and ought not to take the place of a 'contents list' (as Dr. Walsh rightly points out), the arrangement would be most inconvenient. In any case the inclusion of the suggestion without elaboration will only confuse the class of reader for whom this book is designed.

The author has evidently read widely on his subject, but seems to have been unduly influenced by works on general cataloguing and classification, which have to some extent obscured for him the real nature and function of the index. For all that, the book is a practical manual which contains much that will help the inexperienced.

God: in Christian Thought and Experience. By the Rev. W. R. Matthews. (Library of Constructive Theology.) Pp. xix+283. (London: Nisbet and Co., Ltd., 1930.) 10*s.* 6*d.* net.

"To a discerning eye", says Dr. Matthews in his preface, "it must be clear that the main question which is being decided in the world to-day, is whether or not the majority of men shall continue to believe in God." One of the difficulties with which the would-be constructor of a tenable theistic theory is faced is the absence of any generally accepted philosophy. All we can boast is "a generally accepted body of knowledge which stands for the modern world as solid and unquestionable as the logic and metaphysic of Aristotle stood for the later Middle Ages", that is to say, natural science. Yet science does not seem able to provide us with any solution of ultimate problems. Here it leaves us unsatisfied.

There is scope, then, for someone who, starting from the commonly accepted results of natural science, will tell us as much as he can from that point of view, and indicate exactly what we must *not* hope to learn from him. Dr. Matthews does not claim to attack the problem from this end; he takes as his starting-point "the Christian experience of God", and tries, in view of it, to formulate a theory of the divine nature which may be acceptable to the reason, and not contradictory to the knowledge, of modern men. Thus his book will interest theologians more than men of science. Yet scientific workers may well acclaim any work which will enlighten theologians; and this the present volume can scarcely fail to do.

Philosophy and Psychology.

(1) *The Psychology of Insanity.* By Dr. Bernard Hart. (The Cambridge Manuals of Science and Literature.) Fourth edition. Pp. xxxv+176. (Cambridge: At the University Press, 1930.) 3*s.* net.

(2) *Psychopathology: its Development and its Place in Medicine.* By Dr. Bernard Hart. Second edition. Pp. vii+178. (Cambridge: At the University Press, 1929.) 8*s.* 6*d.* net.

(1) Dr. Bernard Hart's little book has been reprinted almost annually since 1918, and now we have a new edition, the fourth. The book gives an extraordinarily good account of insanity and may well be read by any educated layman, particularly the social worker, with great benefit. Hart explains mental mechanisms like projections, which are of such common occurrence in the everyday life of the normal 'man in the street'. This edition has had an introduction specially written for it, in which Hart gives a brief historical account of the influence of Janet but more particularly of Freud. He points out how Freud's views have been developed and extended, although the original ideas remain much the same. We cannot help thinking that everyone ought to read this book, and that the mental hygiene of the community would benefit by it.

(2) In "Psychopathology" Dr. Bernard Hart presents us with his Goulstonian Lectures delivered in 1926, with the addition of three chapters: one on the psychology of rumour, one on the methods of psychotherapy, and one on the conception of dissociation. These last three papers had all been published already. Dr. Hart naturally devotes a large amount of his space to the views of Freud. He also amply considers the views of Jung, but unfortunately appears to have little use for the theories of Adler. These, we think, might have been given more space, as they appeal to quite a number of clinicians who do not accept Freud's all-embracing use of the word sex.

Lectures on Ethics. By Immanuel Kant. Translated from the German by Louis Infield. Pp. xiv+253. (London: Methuen and Co., Ltd., 1930.) 10*s.* 6*d.* net.

It is much to be hoped that this little book will attain a wide circulation. It has several points of special interest, besides being a short handbook of practical morals, easily and pointedly written and with clear anticipation of the great thinker's main construction of ethics, which followed shortly after-

wards, in 1781. The interesting literary point is that we have in this book, taken down very fully or written out immediately afterwards, Kant's own words in lecturing, and the result is very similar, from the literary point of view, to most of the works of Aristotle.

The main note of Kant's moral system is struck in the earlier section, where he puts aside the Aristotelian doctrine of the mean as an obvious idea of no depth or scope, and lays down his own canon of the moral imperative.

Two other points of special interest to contemporary thought stand out conspicuously. One is the frequent reference to the claim of mankind as a whole: "We should have but a low opinion of ourselves as individuals, but as representatives of mankind we ought to hold ourselves in high esteem". We are to do right not because it is the will of God, though we are led also to believe that it is that, but because it is the prerogative of our nature to do so, all mankind speaking to us through the individual conscience.

The other salient point is the ideal agreement of mankind, which gives us in its purest form the sanction of the moral imperative, and should, in the practical and political form, be the object of all good men to achieve by law and institution on earth. Kant's defence and advocacy of a League of Nations is nowhere more convincingly and fervently expressed than in the concluding paragraphs, which might well be adopted as a motto by the League of to-day. F. S. M.

The Human Mind. By Karl A. Menninger. Pp. xiv + 477 + xi. (New York and London: Alfred A. Knopf, 1930.) 21*s*.

Dr. Menninger, who is a well-known American psychiatrist, has attempted to place before the lay reader the problems of mental disorder. This is a difficult task, for the subject is a highly technical one, and to make it intelligible and at the same time preserve its dignity would appear to be a task of the severest. Yet the author has presented what is probably the best account of the human mind viewed from the abnormal side. It is a book which may be read to great advantage by psychiatrists as well as the lay reader. The author's explanation of mental mechanisms looked at from an analytic point of view is excellent; and his case records, which are perhaps the most fascinating part of the book, show an extraordinarily wide and sympathetic understanding of the distraught mind. Some of the explanations of aberrant conduct may appear exaggerated to the uninitiated, but they are very familiar to those who have to deal with the mentally abnormal.

Don Juan and other Psychological Studies. By Prof. Gonzalo R. Lafora. Translated by Janet H. Perry. Pp. 288. (London: Thornton Butterworth, Ltd., 1930.) 7*s*. 6*d*. net.

In "Don Juan and other Psychological Studies", Prof. Lafora, who occupies the chair in psychiatry of the University of Madrid, presents us with a series of most interesting studies of the abnormal. He describes a patient of his own who very closely resembles the personality of Don Juan, and considers that it was quite possible for an individual so hopelessly erotic as Don Juan to have existed. In his chapter on lay and religious miraculous cures, he points out that in Lourdes in 1923 only eighteen out of nearly a million invalids who attended were cured. At the same time, no figures are provided of the many who die or are worn out by the journey. A certain number of the cures relapse, yet we are told nothing of this. In his study of cubism and expressionism he points out, as others have done, the resemblance between this form of art and the drawings of so many of the insane. It is quite impossible to tell from a given picture whether the artist was sane or insane. With this statement of the author's we are heartily in agreement. The book throughout is a most level-headed exposition of the abnormal, and to anyone familiar with the writings and drawings of the insane and mentally unbalanced it will appear by no means as an exaggeration.

Sleep: Why we need It, and How to get It. By Dr. Donald A. Laird and Charles G. Muller. Pp. x + 212. (London: Williams and Norgate, Ltd., 1930.) 6*s*. net.

Laird and Muller have made an excellent attempt to solve some of the problems of sleep in a practical manner. It is typically American. One is inclined to take the statement that 60° F. is too cold for children to do good work *cum grano salis*. The book, however, is full of practical points, such as small hints for diminishing noise, etc. It is doubtful if in Great Britain many people lie and read in bed with a lamp attached to the book they are reading so as to assure a constant volume of light. We cannot imagine moth-balls helping to woo sleep. Coffee is found to be not guilty of very many of the cases of disturbance of sleep laid at its door. Excitement during the evening is a much more important sinner.

Physics.

A Treatise on Light. By Dr. R. A. Houstoun. Sixth edition. Pp. xi + 494. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 12*s*. 6*d*. net.

This treatise, which is now in its sixth edition, is an admirably well balanced book. It is divided into four parts. The first treats of geometrical optics, a subject which some physicists forget is of great practical value. The second discusses physical optics, finishing with the Kerr effect. In part three, spectroscopy and photometry are discussed and the latest developments are described. We expected the author to be more definite about colour-blindness, on which he is an authority; but he has, perhaps wisely, confined himself to a brief statement of the main theories. The descriptions given of the wonderful advances made in spectroscopy, the spectral series, the infra-red, the ultra-violet, and the X-rays will be helpful to many. The last section of the book gives the foundations of the mathematical theory and its later developments, due stress being laid on the quantum theories of the propagation of light and on Poynting's theory

of the pressure of light. The chapter on ether and relativity is interesting. The usual unconvincing statements are made about the relativity of time and space. The author says, "Relativity is consequently now accepted as a faith. It is inadvisable to devote attention to its paradoxical aspects." The warning perhaps means that 'this way madness lies', and many will agree with him. It is pointed out that if we adopt Einstein's theory, since every observer has his own system of space and time, it is easier to abandon the conception of an ether and think of the light itself as having substance and moving through the void. A description of the Hilger interferometer, Moseley's work on X-ray spectra, cosmic radiation, and Kodacolor photography completes this useful volume.

The Physics of Solids and Fluids: with Recent Developments. By P. P. Ewald, Th. Pöschl, and L. Prandtl. Authorised translation by Dr. J. Dougall and W. M. Deans. Pp. xii + 372 + 4 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 17*s.* 6*d.* net.

Although of recent years the attention of physicists has been so much concentrated on electrons and quanta, the study of the properties of matter in the solid and liquid states has made great progress, with the result that text-books on the subject have been growing old-fashioned. This volume contains a number of articles which appeared as part of the eleventh edition of Müller-Pouillet's "Lehrbuch der Physik", and it is satisfactory to have them translated into English and collected in this convenient form. Prof. Pöschl, of Karlsruhe, contributes an interesting chapter on elasticity and strength of materials, and a short chapter on the friction of solid bodies. Prof. Ewald writes a chapter on the mechancial structure of solids from the atomic point of view, in which the lattice theory of crystals is described and a useful account of single crystals is given. Finally, Prof. Prandtl, of Göttingen, contributes three chapters on the equilibrium and the flow of liquids and gases. These are to be recommended to anyone taking up the scientific study of aerodynamics. The illustrations are noteworthy, and special mention must be made of the fine photographs of slip and fracture by Dr. G. Sachs and those of stream-lines in air and in water.

Einführung in die Theorie der Wärme: zum Gebrauch bei Vorträgen, sowie zum Selbstunterricht. Von Prof. Dr. Max Planck. (*Einführung in die theoretische Physik*, von Prof. Dr. Max Planck, Band 5.) Pp. vii + 251. (Leipzig: S. Hirzel, 1930.) 8 gold marks.

This book is the last volume of a series entitled "An Introduction to Theoretical Physics", and it is in keeping with Planck's work that the last volume is on the theory of heat instead of the theory of electricity and magnetism. Planck has shown that the theory of heat can be built upon the foundation of mechanics and electromagnetism.

It is not intended that this volume should replace the two works on thermodynamics and heat radiation, so well known to all students of physics. These branches of the study of heat are treated here in less detail, and an introduction to the theory of heat must have a more general character. It is in four parts, and the content of the first, third, and fourth is familiar to students of Planck's contributions to the theory of heat. These make very pleasant reading, especially the first part, for it is always a delight to read Planck on the laws of thermodynamics. The second part is on the conduction of heat, and is the only part which tends to relieve the work of its rather specialised character. It is an introduction to certain parts of the subject of heat rather than to the general theory.

Les quanta. Par Prof. Georges Déjardin. (Collection Armand Colin: Section de physique, No. 121.) Pp. 224. (Paris: Armand Colin, 1930.) 10·50 francs.

Prof. Déjardin's "modeste ouvrage" is actually an exceptionally good account of quantum theory. in which he shows a nice appreciation of the extent to which mathematics can be tolerated by the ordinary honours student of physics. The course followed is the historical one, the radiation problem being taken first, and, after that, specific heats, the photoelectric effect, the scattering of X-rays, elementary spectroscopic theory, and, finally, the new quantum mechanics. Details of experiments are not given, but there is no lack of illustrative results, generally from fairly recent publications. There is a great deal to be said for the omission of such details even from more pretentious treatises, the student being left to refer to original papers for these—with, of course, precise directions as to what he is to read. Prof. Déjardin has succeeded in covering much ground in this small and inexpensive volume, which, if read in conjunction with P. Bricout's "Ondes et électrons", in the same series, furnishes a very satisfactory course on modern physics.

Theoretical Mechanics: the Theory of the Potential. By Prof. William Duncan MacMillan. Pp. xiii + 469. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 25*s.* net.

To the author's remark that the theory of the potential is very useful from the point of view of the physicist and very beautiful from the point of view of the mathematician, we may add that it introduces a class of functions of fundamental importance in connexion with wave mechanics. Whether they are best approached for this purpose in the way given by Prof. Macmillan is perhaps questionable, but there is no doubt that anyone who had worked through this volume would be quite familiar with many of their properties. The ground covered is much the same as in several of the larger treatises on electricity, but the subject is here approached with a minimum of specific reference to the nature of the field. A knowledge of the theory of integral equations is not assumed. The one criticism offered is that rather much space has been devoted in the early chapters to the solution of distinctly elementary problems.

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Baillière, Tindall and Cox.—Manual of Research and Reports, with special application to Investigations in the Field of Business, Economic and Public Affairs. *Cambridge University Press.*—Scientific Inference, Dr. H. Jeffreys. *Oxford University Press.*—The Physical Basis of Rime, H. Lanz. *Routledge and Kegan Paul, Ltd.*—Reason and Nature, Prof. M. R. Cohen; The Physiology of Beauty, A. Sewell, with Introduction by Prof. L. Hogben. *Williams and Norgate, Ltd.*—Science To-day and To-morrow, compiled from a Series of Lectures delivered at Morley College, Sir Frank Dyson, Dr. E. Miller, Prof. G. Elliot Smith, Dr. Jane Walker, Dr. J. Needham, Prof. H. Levy, Prof. Winifred Cullis, Sir A. W. Hill and Prof. W. T. Gordon.

Philosophy and Psychology.

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Technology.

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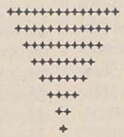

Printed in Great Britain by R. & R. Clark, Limited, *Edinburgh.*

a Camera". Mr. Maxwell visited the Birunga mountains in the spring of 1925 to study the habits and habitat of the eastern gorilla. The series includes a photograph of a female gorilla startled by the photographer and making off in the foreground, carrying her young one on her back; and one showing the head and shoulders of an old male gorilla peering out from a dense curtain of tropical vegetation. There is also a series of photographs of gorilla beds, or 'nests'; one is constructed in the fork of a tree about 4 feet from the ground, but the older gorillas appear to prefer their beds on the ground itself, probably because they have little fear of leopards. The Trustees have agreed to the purchase of a valuable collection of West African birds made by Mr. G. L. Bates, principally in the highlands of the north-eastern part of Sierra Leone and the adjacent French territory. On the isolated peaks culminating in Mount Nimba were procured stonechats and pipits, the nearest relations of which are in the Cameroon highlands, hundreds of miles to the south. Two specimens and photographs of the 'Coco de Mer' (*Lodoicea Sechellarum* Labill) have been presented to the Department of Botany by Miss Royston of Clophill, Bedfordshire. The fruits are those of a palm which is restricted to the Seychelles, and were found floating in the Indian Ocean long before the tree itself was known. The fruit is one of the largest known; the weight of one of those presented, though the specimen is hollow, is 30 lb. A collection of some 2600 letters, many containing valuable mycological data, addressed to William Phillips, have been presented by Mr. J. Ramsbottom. Phillips was a well-known mycologist of the latter part of the last century, and wrote the "Manual of the British Discomycetes".

PROF. S. HANZLIK has published a useful preliminary report on the unification of rainfall recording in *Bulletin* No. 5 of Section d'Hydrologie, Union Géodésique et Géophysique Internationale, Venice, 1927. Numerous kinds of rain gauges are used in different countries, with reception areas ranging from 64 to 1000 square centimetres. There is equally great variation in the height of the sides of the rain gauge and in other features. Various practices obtain in the measure of snowfall. Self-registering rain gauges differ widely in principle. The amount of rainfall in some countries is recorded on the day it falls: in others on the day it is measured, which is the day following its fall. Generally a "rainy day" is one on which at least 0·01 mm. of rain fell, but in some countries 0·02 or even 0·5 mm. is the minimum. In some statistics the days with certain quantities of rain are distinguished; in others different quantities are chosen. There are also various practices in the recording of frost and other phenomena. The report is based on inquiries addressed to seventy-eight meteorological institutes throughout the world. It is not exhaustive, but yet is of much interest; and if it does nothing to suggest uniformity, it shows at least the wide diversity of methods employed in various countries. Without some measure of uniformity, the comparison and discussion of meteorological data are made unnecessarily difficult.

THE Ordnance Survey has published a map of seventeenth century England and Wales as the second of the series of period maps of which Roman Britain was the first. The basis of this map is a layer coloured, contoured sheet on a scale of one to a million. The main roads are taken from Ogilby's survey of 1672. The principal ports and towns are shown by different symbols which indicate their importance. Other symbols are used for castles, large houses, forts, and camp sites. The chief events of the Civil War, with their dates, are indicated. In many parts of the country the principal economic products are marked. Forests are indicated by names but not symbols. In spite of the large amount of information given, the map is clear and legible and gives no impression of crowding. It is both a useful document and a fine specimen of cartographical skill. A small plan of contemporary London is bound up with the map. Prof. G. M. Trevelyan contributes a short introduction on the general appearance of England in that century, and Dr. J. E. Morris gives an outline of the campaigns of the Civil War. There are also lists of events and prominent persons of the century. Full details of the sources of the map are given. The map alone is published on paper at two and sixpence, or mounted on linen with letterpress at six shillings. The plan of London can be obtained separately at one shilling.

The Reports on the health of the Navy and of the Army for the year 1929 have recently been issued (London: H.M. Stationery Office. Price 2*s.* 6*d.* and 3*s.* net, respectively). In the Navy, the ratio of the incidence of disease was 482·03 per 1000 of the strength, being an increase of 36·04 over 1928 and of 14·91 in comparison with the five years' average. There was some increase in venereal diseases, with 6361 cases, and in malaria; and a number of cases of influenza occurred. On the other hand, there were only three cases of typhoid fever and two of paratyphoid fever, a remarkable record in a force of 86,240 men. The total number of deaths was 254, of which 101 were due to injury. In the Army, likewise, there has been some increase in the incidence of disease, the admission ratio having risen from 426·2 in 1928 to 468·5 in 1929 per 1000 of the strength. This increase was, however, mainly due to an epidemic of influenza in the home commands, during the early months of the year. Several diseases show a slight increase in the admission ratio compared with 1928, and the death and invaliding ratios also show slight increases. Tonsilitis, which has been increasingly prevalent during recent years, again shows an increase. There were more cases of malaria in India, and one case of this disease arising in England is mentioned. The patient had never been to a malarious country, and had been for more than ten years continuously in Great Britain. The malaria parasite was found in his blood, so that there is no question of the diagnosis. Venereal diseases show a satisfactory decrease.

FOSSIL shells of ostrich eggs were found by the 1923 expedition of the American Museum of Natural History in the Central Gobi, and now A. Tugarinov

(*Priroda*, 1930, No. 7-8) reports the discovery of fragments of such shells in a number of localities around Troitzkosavsk, in Transbaikalia, which means a considerable northward extension of the area where ostriches occurred. Most of the finds were made in an association with various objects of palæolithic culture, but in one case, fragments of shells were found away from any traces of human habitation. The association of the shells with palæolithic camps and the fact that some fragments are perforated indicate that they were used as a material for making utensils. As may be concluded from the size and the structure of the shells, they belonged to a species closely allied to *Struthio camelus*, the living North African ostrich, which differs strongly in these respects from the more southern species. However, it does not appear possible to identify the Transbaikalian species with the North African one. This discovery forms an interesting counterpart to the fact that the environs of Troitzkosavsk harbour fossil remains of an antelope of the genus *Spirocerus*, also allied to some recent African genera.

RECENTLY we referred in these notes to the many problems of bird life in Britain which still await solution. Yet birds are the creatures most observed by the amateur naturalist. It need scarcely be said, therefore, that our knowledge of the habits, life-histories, and reactions of mammals has many blanks, in spite of the fact that few branches of inquiry are of greater interest to the naturalist or of more practical importance to the agriculturist. Moreover, it is just along the lines of observation most open to the field naturalist, such as the relationships of animals to their environment or the fluctuations of their numbers seasonally and annually, that further information is needed. An excellent guide for the worker who desires to make useful contributions to such knowledge is Walter P. Taylor's "Outlines for Studies of Mammalian Life Histories", a 12-page pamphlet recently issued in revised form by the U.S. Department of Agriculture (*Miscell. Pub.*, No. 86, 1930). In the comprehensive scheme of studies outlined there, the author indicates the observations which ought to be made in elucidating the environment and its influence, the life-history, structure and behaviour, and the relationship between the lower mammals and man. The suggestions should stimulate systematised observations in the field.

WE have received a letter from Col. L. A. Waddell n which he takes exception to our notice of his book, "Egyptian Civilization: its Sumerian Origin", in NATURE of Jan. 24. He states that the fact is overlooked that it gives the fully attested inscriptional evidence for the complete identity of the pre-dynastic and dynastic Pharaohs with Sumerian emperors and their dynasties in Mesopotamia, based on the exact agreement which has been worked out for their names, achievements, and order of succession. He adds that so far from his chronology "hanging in the air", he has provided a solid foundation of fact for the first time for a chronology of Egypt, whereas those who follow what our notice termed the "orthodox" system differ among themselves by some thousands of years in the dates of the early dynasties. While we have pleasure in placing Col. Waddell's protest on record, it is evident that it restates, in brief, the argument of his book, which is dependent upon identifications which, it was made clear, we were not prepared to accept.

GREAT progress has been made in the United States of America in the formation of children's museums. In discussing "Children's Museums in our National Life", at Yale University on Nov. 19, Miss Anna B. Gallup pointed out that such institutions are now flourishing in Detroit, Indianapolis, Boston, Hartford, and Los Angeles, besides the children's museums maintained by Harvard and Yale Universities. In addition to these seven, all established after the organisation of the original example at Brooklyn, others are on the way. In Kansas City a small museum for children is soon to be opened, another is being planned as part of the California Academy of Sciences, and in Pasadena the movement has taken hold. Even in Honolulu a building has been under consideration for the use of children, and a representative has studied the methods of the Brooklyn Children's Museum in order that the most may be made of the educational possibilities of the venture.

THE *Bulletin* of the Michigan College of Mining and Technology for the year 1930–1931, which has recently been issued, contains full schedules of the subjects taught at this seat of learning. Judging by the scope of the work detailed for chemistry, engineering, mining, metallurgy, etc., and from the illustrations scattered through the book, a very thorough education is made possible by the possession of first-class equipment housed in ideal buildings and handled by a very competent staff. That is where these schools of advanced instruction in the United States score over so many British centres of learning of similar standing; lack of adequate equipment or accommodation is bemoaned in almost every university in Great Britain in some faculty or other, but it is seldom that the same cry is heard from the other side. To those interested in schemes of work and curricula, in questions of relative number of hours per subject in a group chosen for a degree course, it is instructive to turn to publications which tell us how other people do things, how qualifications are secured. While headings and schedules can give little idea of the quality of the teaching or of the standard really achieved, short of or compatible with the aims professed, much can be learned from perusal of a pamphlet of this kind, and correct assessment of international educational values is only one of the advantages ensuing therefrom.

A GREAT deal of interesting matter on the methods and practice of boundary determination and demarcation is contained in *Bulletin* 817 of the United States Geological Survey, entitled "Boundaries, Areas, Geographic Centers and Altitudes of the United States and the Several States". The history and the methods of marking the boundaries are given for all the States and for the international frontiers. In several cases a lack of understanding of physical geo-

graphy led to boundary disputes and readjustments, as in the case of the shifting bed of the Rio Grande between Texas and Mexico, or the Alaskan boundary dispute of 1898. The pamphlet contains also a great deal of statistical matter and several maps. Of the latter, the most interesting is a large reproduction of the Mitchell map of British and French dominions in North America in 1755, on a scale of about fifty miles to an inch.

PROF. R. F. GRIGGS, of George Washington University, has recently returned from a botanical expedition to the Katmai volcanic region of Alaska (*Daily Science News Bulletin*, Science Service, Washington, D.C.). About twenty years ago, Katmai practically exploded and devastated a great area of country, which was left covered with volcanic ash. This covering was almost devoid of nitrogen, and Prof. Griggs has paid special attention to the plants which first populated this bare and arid soil. The first plants were liverworts, and although there is little or no nitrogen in the soil, it is, of course, present in the plants themselves. It is not clear at present whether the liverworts have the capacity to take nitrogen from the air themselves, or whether this power is associated with some fungus growing in close association with them. Such close mycorrhiza-like union of a fungus with a liverwort has been described on several occasions. Prof. Griggs proposes to study the question further on this group of plants, in the laboratory.

DR. WILLEM DE SITTER, director of the Observatory at Leyden, has been awarded the Catherine Wolfe Bruce gold medal for 1931 of the Astronomical Society of the Pacific "for distinguished services to Astronomy".

THE special exhibition at the Imperial Institute, South Kensington, of the mineral resources of the Empire, which was noted in NATURE, Feb. 14, p. 248, will remain open until April 30. In connexion with this exhibition, Sir Edwin Pascoe, director of the Geological Survey of India, will give an address on "The Mineral Wealth of India", on Mar. 12, at 5.30 P.M. Tickets for seats may be obtained from the Secretary, Imperial Institute, South Kensington, S.W.7.

THE fifth general meeting of the 'Dechema' (Deutsche Gesellschaft für chemisches Apparatewesen) will be held, with that of the Verein deutscher Chemiker, in Vienna, on May 28 and 29. The subject chosen for the symposium is "The Separation of Solid and Liquid Substances". Offers of contributions should be sent in not later than Mar. 15, to the head office of the 'Dechema', Seelze b. Hannover.

DR. E. R. WEIDLEIN, director of the Mellon Institute of Industrial Research, Pittsburgh, Pa., has announced the appointment of Dr. L. H. Cretcher to an assistant directorship in the Institute. Dr. Cretcher, who, since 1926, has been serving as head of the Institute's Department of Research in Pure Chemistry, will be in charge of a group of industrial fellowships concerned with problems in organo-chemical technology. Dr. Cretcher was formerly a member of the organo-chemical division of the Rockefeller Institute, and in 1919 took up a research post in the laboratory of the National Aniline and Chemical Company. He is best known for his work on sugar chemistry. He has also contributed to the knowledge of pyrimidine aldehydes, oxidation of tertiary hydrocarbons, glycol ethers and esters, organic boron compounds, barbituric acids, chloro ethers, and equilibria in binary liquids systems.

WE have received from the Association of British Chemical Manufacturers, 166 Piccadilly, London, W.1, a well-bound volume of 405 pages entitled "British Chemicals and their Manufacturers", which is printed in English and five other languages, French, Spanish, Italian, Portuguese, and German. All the entries are classified under products in separate indexes in these languages. There is also a section dealing with products under proprietary and trade names, the nature of the product being stated in the languages mentioned. The volume may be obtained gratis by genuine users of chemicals on application to the Association at the address given above.

A CATALOGUE (No. 15) of upwards of 300 second-hand works on botany, horticulture, zoology, and geology has just been issued by Mr. J. H. Knowles, 92 Solon Road, S.W.2.

THREE short lists (B.7, B.8, and B.9) of second-hand books on, respectively, botany, gardening and agriculture, natural history, and angling, fish, and fishing have just reached us from Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, W.8.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A junior research assistant in the department of chemical technology of the Imperial College of Science and Technology—The Registrar, Imperial College of Science and Technology, South Kensington, S.W.7 (Mar. 12). A sub-inspector of quarries in the North Midland Division of the Mines Inspectorate of the Mines Department—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (Mar. 16). A chemical assistant to the advisory chemist of the School of Agriculture, Cambridge—The Secretary, School of Agriculture, Cambridge (Mar. 19). Lecturers in, respectively, geography and mathematics and physical training and hygiene, at St. Hild's Training College, Durham—The Principal, St. Hild's Training College, Durham (Mar. 20). A full-time lecturer in civil and mechanical engineering at the Polytechnic, Regent Street—The Director of Education, The Polytechnic, Regent Street, W.1 (Mar. 20). An assistant secretary under the Middlesex Education Committee, having special knowledge of technical education and with experience in courses leading to national certificates in electrical and mechanical engineering and in building construction—The Secretary, Education Offices (H.), 10 Great George Street, S.W.1 (Mar. 21). A professor of economics in the Panjab University—The Secretary, Universities Bureau, 88A Gower Street, W.C.1 (Mar. 28). A director of the Research Institute of the Rubber Research Scheme of Ceylon—

The Chairman of the Board of Management, Rubber Research Scheme, Peradeniya, Ceylon (Mar. 30). A deputy director of the Public Health Laboratories, Cairo—The Under-Secretary of State, Department of Public Health, Cairo (April 14). A demonstrator in physics at Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (April 20). A lecturer and adviser in veterinary science in the Harper Adams Agricultural College and National Institute of Poultry Husbandry—The Principal, H.A.A.C., Newport, Shropshire.

ERRATUM.—NATURE, Feb. 21, p. 268, five lines from end of notice of "The Economics of Forestry" by W. E. Hiley: for "British Isles" read "British Empire".

Our Astronomical Column.

Mapping the Larger Magellanic Cloud.—A recent *Daily Science News Bulletin* issued by Science Service, Washington, D.C., gives a summary of a paper by Prof. H. Shapley read before the American Association for the Advancement of Science at the recent Cleveland meeting; he stated that a detailed map of the larger cloud is being prepared; the cloud contains 200,000 giant and supergiant stars, each more than 150 times as bright as the sun, and more than 2000 stars that are each more than 10,000 times as bright as the sun.

Another *Bulletin* gives a new estimate of the distance of the sun from the centre of the galaxy. Dr. Harlow Shapley had found a distance of 15,400 parsecs by taking the mean of two different methods; but, since that was made, Dr. R. J. Trumpler has found evidence of appreciable absorption of light in the galactic plane; Dr. van de Kamp has applied the necessary correction to Dr. Shapley's figures, and finds that the distance is reduced to some 12,000 parsecs, or even less.

The Eighth Satellite of Jupiter.—This tiny body, the magnitude of which is 17½, has been unobserved since June 1923. It was discovered by Mr. Melotte at Greenwich in 1908, and was followed there for many years; but of late years the Thomson Equatorial, which is the only instrument there that is suitable for observing it, has been in use for stellar parallax and other researches. There was danger of its being lost, as the solar perturbations are very large and the computation of them long and tedious. However, Prof. Numerov, of Leningrad, computed them a few months ago, and issued an ephemeris; Prof. G. van Biesbroeck has succeeded in photographing the satellite, and publishes eight positions, obtained from photographs on four nights, in *U.A.I. Circ.* No. 310. The first position is:

	R.A. (1930·0).	N. Decl.
Dec. 16. 20562 U.T.	7h 25m 36·46s	22° 54′ 50·3″

The observed places are about 8 sec. smaller in R.A. than the predicted ones, and 10′ north of them. These residuals are satisfactorily small after an interval of nearly eight years. The plates were taken with the 24-inch reflector at Yerkes, with an exposure of 30 minutes.

Variable Stars in the Globular Cluster Messier 3 (Canes Venatici).—*Astr. Nach.*, No. 5747, contains a study of the light variations of 47 stars in this cluster, by Mr. Paul Slavenas. The plates used were 97 in number, and were taken by Dr. J. Schilt in 1926 with the 60-inch reflector at Mt. Wilson. The data for 30 stars were sufficient to deduce accurate periods: these are given to the eighth decimal of a day; the shortest is about 0·288 day, the longest 0·708 day. The majority lie close to half a day. It will be remembered that it was from a study of the magnitudes and periods of Cepheids that the distances of globular clusters, the Magellanic Clouds, and the spiral nebulæ have been determined.

Reference Stars for the 'Selected Areas.'—The scheme, initiated by the late Prof. Kapteyn, of intensive observations of stars, both bright and faint, in certain areas distributed uniformly over the entire heavens, needs very careful meridian observations of the brighter stars in each area, since these have to serve as reference points for the plate constants, and the proper motions of the faint stars will depend upon them. The Observatory of Leyden has just produced a catalogue of 1172 of these stars in vol. 15, part 3, of its *Annals*. They include all the 'areas' in the northern hemisphere except the polar one. The catalogue bears the names of C. H. Hins and J. J. Raimond, jr., with Prof. de Sitter as director. The observations were made between 1921 and 1929. In 1922 a hand-driven moving-wire micrometer was inserted. As there is no movable declination thread, the declinations were observed at different times from the Right Ascensions, the eye-end of the telescope being turned through a right angle. Most of the stars have been observed at least twice in R.A. and three times in Declination. The positions are reduced to the equinox of 1925·0.

Occultation of Antares.—Kwasan Observatory *Bulletin* No. 189 contains an observation of the occultation of Antares on Jan. 15 by Prof. K. Nakamura with the 30-cm. Cooke refractor. It was cloudy for the disappearance. At the reappearance, the greenish companion emerged first, and the bright star some 4 seconds later. It was seen first as a dim red glare, and took fully a tenth of a second to reach full brightness. This is in good accord with the large diameter of the star, about 0·04″, found by the Mount Wilson interferometer. The times of emersion in U.T. are:

1931. Jan. 14d 20h 2m 27s companion.
30·9 Antares.

The first time is noted as probably late.

It is of interest to note that the first observation of the companion was made on the occasion of an occultation. The *Berliner Jahrbuch* of 1822 records that Burg at Vienna observed the small star reappear five or six seconds before the bright one on April 13, 1819. He concluded that Antares is double. Bode, however, discredited this, and added the note, "Antares ist kein Doppelstern". The companion was not seen again until 1844 (by Grant in India) and 1845 (by Mitchel in America). Incidentally the green colour of the companion is shown to be inherent, not a contrast effect, when it reappears before the bright star.

The Cracow Astronomical Handbook for 1931.—This handbook, as usual, is almost entirely taken up with ephemerides of variable stars. There are 391 eclipsing variables for which the dates of minimum are given, and 382 others for which certain elements are given. There are also elements of occultations of stars by the moon for several stations in Poland. There are also useful tables of precession, obliquity of ecliptic, etc. The explanations are given both in Polish and in flexible Latin, which is very easy to read.

Research Items.

Food Supply of India.—In the presidential address delivered to the agricultural section at the seventeenth meeting of the Indian Science Congress at Allahabad (Calcutta: Asiatic Society of Bengal), G. Clarke discussed the necessity of increasing the food supply to meet the needs of the growing population in India. From a consideration of the agricultural returns for 1922–23 and 1925–26, it is evident that the area available for food production in India is 1·2 acres per unit population, whereas in America and France, countries comparable with India as regards the importance of agriculture, the corresponding figures are 2·6 and 2·3 respectively. The amount of new land in India suitable for cultivation is no longer sufficient to provide the increased area required, so that the solution of the problem lies in increasing the yield of the land already in use. Weather conditions and the shortness of the growing season are the chief difficulties confronting the agriculturist, but the use of modern methods of research, and in particular a closer study of the critical periods of crops, that is, those intervals during which the plant shows maximum sensibility to external factors such as moisture or nitrogen supplies, should do much towards the attainment of better results. Further, green manuring is particularly advocated as an economical means for soil improvement and the maintenance of an adequate nitrogen supply. From a comparison of conditions in other countries and analogy with the progress of the sugar-cane industry in India, it is possible to obtain a rough estimate of the increased production likely to follow the application of scientific methods to agriculture. After making due allowance for the inevitable lag in the adoption of improvements, and taking into consideration the abundant labour resources and responsive nature of the soil in India, it is thought that within the next two or three decades an increased output of 30 per cent in normal seasons may reasonably be expected. Increased expenditure on scientific research is, however, assumed.

Bionomics and Morphology of *Paraphædon tumidulus*.—The intensive study of an organism is useful in entomology. By making facts of structure known, it places in the hands of the morphologist material with which he can arrive at ideas of truer relationships. It also serves as a means of giving clues of weak points in the insect's anatomy which may be used by the economic entomologist to bring it under control, if it is injurious in any way. Dr. Nellie F. Paterson's recently published paper entitled "The Bionomics and Morphology of the early stages of *Paraphœdon tumidulus* Germ." (*Proc. Zool. Soc.*, Oct. 22, 1930, pp. 627-676) is an effort of this nature. The insect belongs to the Chrysomelidæ—a large family of beetles which are all phytophagous; and consequently many of them are serious pests of cultivated plants. The study was made in the zoological laboratory of the University of Cambridge while the author was holding a scholarship awarded by the University of the Witwatersrand, Johannesburg. The study contains notes on geographical distribution, food-plants and nature of damage, and details of life-history. The exoskeleton and the internal anatomy are reviewed in great detail. The paper is illustrated by four plates and seventeen text-figures. An interesting feature is that the author has formulated a system of enumeration and nomenclature of the larval chætotaxy. Although it may apply to some Chrysomelid larvæ, it cannot be a comprehensive scheme which would embrace the whole family. Dr. Paterson is to be congratulated on her fine study.

An Australian Myriothela.—E. A. Briggs (*Rec. Austr. Mus.*, Sydney, **18**, 1930) gives an account of the salient features in the histology of *Myriothela harrisoni* from the coast of New South Wales. The ectoderm of the hydranth is described as stratified; the supporting lamella is thin and from its outer surface extend simple or branched secondary lamellæ, on each side of which the well-developed longitudinal muscle fibrils of the ectoderm are situated. The endoderm presents the usual types of cells—goblet, gland, vacuolate, and storage. The tentacles of the hydranth are remarkable for the extraordinary development of the supporting lamella in the capitulum where it is produced into radially arranged fibres which form the main mass in the apex of the tentacle. The fibres keep this part of the tentacle expanded when the remainder is contracted. The blastostyles, which are borne on the middle zone of the hydranth in such numbers as to hide the surface, are mouthless, and each is continued into a single terminal tentacle. The mature gonophores borne on any one individual are of the same sex; both male and female gonophores have an apical opening representing the velar aperture.

Biological Control of the Prickly Pear.—Several species of *Opuntia* have spread very widely in Australia since their accidental introduction, and two species, *O. inermis* and *O. stricta*, have become very serious pests. In 1912, the Queensland Government appointed a commission to investigate the natural enemies of these plants, and since 1919 the Commonwealth Government has co-operated with Queensland and New South Wales, the work of searching for natural enemies of the prickly pear in its natural haunts being placed under the control of the Commonwealth Prickly Pear Board. The whole of the cactus belt in the United States was examined, and some seventy different kinds of insects were found on the prickly pear. Under the title, "Ten Years' Research on the Prickly Pear", C. Schindler, of the University of Brisbane, gives an account of this work in *Discovery* for February. Very striking success appears to have accompanied the introduction of the moth, *Cactoblastis cactorum*, which was found in La Plata in 1914, and re-discovered in the Argentine and Uruguay in 1925. A shipment of eggs reached Australia safely in 1925 and was an immediate success. The caterpillar tunnels in the fleshy stem and, living gregariously inside this spine-covered fleshy mass, is protected against birds. Schindler estimates that the area covered by the prickly pear in Australia is now being reduced by one million acres a year, as a result of the various methods of biological control now in use, instead of this pest spreading to about the same acreage of new country each year, as was formerly the case. This Australian work will have considerable interest for other countries, for example, South Africa.

Spiral Ringing and Solute Movement in Trees.—Profs. L. H. McDaniels and O. F. Curtis have published the results of their latest experiments on the ringing of trees in *Memoir* 133 of Cornell University Agricultural Experiment Station (October, 1930, 31 pages). The results refer mainly to the spiral ringing of apple trees, and the findings confirm the opinion of these workers that the phloem is the tissue most concerned in translocation, handling solutes taken in by the roots and foodstuffs elaborated in the leaves. Photographs showing the effect of spiral ringing in increasing the fruitfulness of apple branches are given,

and the practice of tapping trees for oleoresin is also reviewed. Lateral transference of solutes and foodstuffs in the trunk is shown to be slow, immediately after the ring has been made. It is suggested that the meeting of the downwardly moving foodstuffs and the upwardly directed solute current causes an electrical polarity of the cells at the junction, that is, the incipient cambium, and the responses of plants to such practices as propagation, pruning, and grafting are discussed from this point of view. The regeneration of the tissues following ringing has been studied, and leads to the conclusion that translocation rapidly becomes normal after the wounding.

Selection of Maize for Germination and other Tests.—Mr. R. C. Malhotra, of St. Mary's College, Kansas, writes to say that in germination tests of maize seedlings he finds that the irregularly shaped seeds taken from the tip and butt ends of the ear, especially those in which the embryo is located at the side of the seed, seldom if ever germinate. The use of such seeds, even if of heavy weight, may cause an experimental error of 20-25 per cent in germination. In the middle of some ears a number of compressed, thin, undeveloped, and starved seeds may be found. They germinate promptly, probably because of the thin pericarp, but produce poor, under-nourished seedlings and should be excluded from germination experiments. In experiments with X-rays and ultra-violet light, the effect of exposure is very different according to which side of the seed is exposed, as the embryo is much nearer one side than the other. The embryo side should be exposed for uniform results.

The Theory of Isostasy.—In a critical review of isostasy by Hubbert and Melton, appearing in the *Jour. Geol.*, pp. 673–695, 1930, the underlying theory is very clearly summarised, and special attention is directed to Hopfner's recent inquiry into the problems involved. Hopfner claims that the observed gravity anomalies can be accounted for, without recourse to the principle of isostasy, by taking into consideration the effect of elevation and depression of the geoid relative to the spheroid of reference (Brun's term). These effects lead to the conclusion that gravity ought to be deficient over the continents and excessive over the oceans, as indeed it is, this being the leading fact that isostasy has been invoked to explain. The authors state that although the results of Hopfner are admittedly qualitative, "they are of sufficient importance to cast a large shadow of doubt over the whole of isostatic theory". Against this depressing conclusion there appears simultaneously an important paper by Heiskanen in the *Am. Jour. Sci.*, Jan. 1931, pp. 39-50. It is admitted that the reduced gravity values g_0 are referred to the geoid, whereas the theoretical values γ are referred to the spheroid, but several lines of evidence are presented to demonstrate that gravity anomalies could be explained by Brun's term only if its quantitative value were about ten times greater than it actually appears to be. Heiskanen concludes that Hopfner's arguments are founded on a qualitatively correct basis; but that he has greatly exaggerated the influence of the effects deduced. Readers of the first paper referred to above should on no account omit to study the second. Taken together, they provide a most illuminating account of an intricate subject that is rarely clearly understood.

Gas in Relation to Oil Production.—B. J. Ellis discussed this subject at the meeting of the Institution of Petroleum Technologists last December, and, in effect, gave a very practical interpretation of S. C. Herold's well-known recent work on simple perfect fluids and their mechanics. As he (Mr. Ellis) pointed out, Herold's thesis deals in the main with ideals—perfect gases and liquids in homogeneous reservoirs; and although the principles enunciated have obvious application to oilfield circumstances, such conditions cannot be realised in actual practice. The author proceeded to examine the concrete variables, the gas, oil, and the reservoir, as existing in Nature, and thereafter sought to modify Herold's theories in terms of actual conditions. Such a study is bound to bring in its train the more practical questions of repressuring oil pools and gas drive, and some attention was devoted to these aspects of field-development, while a possible method of increasing the recovery of petroleum by a modified form of gas drive was indicated. In this latter conception is probably the most interesting part of the paper. What is known as 'centripetal production' was shown to be one of the best means of obtaining more oil from a reservoir from which utmost production had been obtained by normal methods, a means apparently applicable, at least in theory, to virgin production. Briefly, centripetal production implies the injection of gas by wells specially drilled for the purpose at geometrical points determined by the positions of output wells and their circles of influence; injection should take place at a pressure equal to or slightly higher than the original reservoir pressure.

River Flow Records in the Ness Basin, Inverness-shire.—Previous notice has been given in NATURE (Mar. 1 and 29, 1930, pp. 334, 514) at some length of the series of observations of river flow in the Ness Basin, Inverness-shire, made in 1929 by the voluntary organisation known as River Flow Records, under the direction of Capt. W. N. McClean, of Parliament Mansions, Victoria Street, S.W.1. These observations have since been extended to cover the period from January to September inclusive, 1930, and the results relating to the river Garry are embodied in three quarterly reports recently issued. The reports show that during the period in question, in addition to rainfall observation, there have been five months actually spent on river gauging work, with the design and construction of new gear for flood measurements and the erection and maintenance of water-level gauges. Much useful and interesting data have been acquired and, for local, and even general reference, the statistical tables will be of great value. The latest of the three reports provides an opportunity of comparing the flow and period losses of the two rivers, Garry and Moriston, over a full twelve months period, from which it may be noted that while both have catchment areas of 150 square miles, the twelve months' flow-off of the Moriston is about 73 per cent of that of the Garry. The 'period losses' in each case were fractionally above and below 14 inches. The report concludes with some comments on the organisation required to maintain these records of flow after the actual gauging work is completed.

A Gyroscopic Clinograph.—Another interesting application of the gyroscope is the subject of an article entitled "Oil Well Surveying with the Gyroscope", in the November issue of the *Sperryscope*, the organ of the Sperry Gyroscope Company, Inc. In the boring of oil wells many things lead to a deflection of the path of the drill from the vertical, and it is important to the driller that he should be informed of any such deflection. There are several methods by which the angularity of an oil well can be determined, and some success was obtained with the use of the magnetic compass. In conjunction with the Sun Oil Company, the Sperry Gyroscope Company has now brought out the 'Surwel' gyro-

scopic clinograph. In this apparatus are incorporated a gyroscope with its axis set north and south, a box-level gauge, a chronometer, and a film camera, these parts being contained in a steel cylinder 5½ in. in diameter, which can be lowered down the well. The bubble in the box-level shows the inclination; a pointer on the gyroscope gives the direction of the inclination; while the camera, timed by the chronometer, takes a series of photographs of bubble, pointer, and chronometer hands. As the rate of lowering is known, the exact depth at which each camera observation is made can be found, and thus the inclination and its direction can be determined at any given depth. The data recorded on the film can also be plotted on squared paper and a graphic picture of the well's course through the ground can be obtained.

Loud Speaker Acoustics.—The design of commercial loud speakers is largely empirical and, indeed, a complete theoretical treatment of the problem is not yet possible. A number of important factors affecting the reproduction of speech and music by coil- and reed-driven speakers are discussed in a paper by N. W. McLachlan and G. A. V. Sowter (*Phil. Mag.*, **11**, pp. 1-54). It is shown that a *rigid* coil- or reed-driven disc system would be of little value in the reproduction of either speech or music. The energy from the coil-driven disc decreases very rapidly above 1000 cycles, whereas the energy from the reed-driven disc is centred round the resonance frequency of the combination. A reed-driven *flexible* disc fails as a reproducer, owing to prominent, widely spaced, natural frequencies due to the limited number of modes of vibration of the disc in the audible frequencies. Actual coil- and reed-driven diaphragms give better reproduction than would be expected from the rigid disc theory, and they possess an almost continuous succession of minor resonances. The theoretical conclusions are supported by experimental evidence. Measurements of the radial velocity of sound in discs were made, and it was found that near the periphery of a conical diaphragm the velocity is considerably less than in air. A summary of sixteen electrical, acoustical, and mechanical factors causing distortion in the reproduction by moving coil systems is given at the end of the paper and indicates the extreme complexity of the problem.

Records of Slow Electrons.—In a paper by P. H. Carr in the December number of the *Review of Scientific Instruments* an account is given of a very promising method for recording slow electrons of energy less than 100 electron-volts. A piece of metal, which may be either in a massive form or a sputtered film, is mounted in the vacuum apparatus, in exactly the same position as a photographic plate would be. After exposure to the beam of electrons, the speed of which is readily controlled by magnetic sorting, the metal is treated chemically, when, with the appropriate reagents, a visible trace of the area of impact appears. Gold, silver, and zinc have been studied in the greatest detail; the best developing agents for the latent images were found to be mercury, iodine, and hydrogen chloride respectively, all in the vapour phase. Gold gives the greatest contrast if the images are to be reproduced afterwards by ordinary photography, but with silver striking colour effects can be produced, which are especially useful for demonstration of the effect. Zinc is the least trustworthy of the three metals, but when images are present on it, they are of excellent definition. It appears that although the technique involved is rather laborious, yet the method is less liable to failure with the slowest electrons than ordinary photography, whilst it has the great advantage that it is not subject to interference from light, either extraneous or from hot filaments within the apparatus.

Isotopes of Beryllium.—The element beryllium occupies rather an anomalous position in that it appears to be a simple element of mass 9, although, from the properties of other elements, it might be expected to have an isotope of mass 8. Evidence for the existence of this isotope has now been found by W. W. Watson and A. E. Parker, from a study of the band spectrum of beryllium hydride in the neighbourhood of 5000 A. (*Physical Review*, vol. 37, Jan. 15). When this is photographed in the third order of a 21-ft. concave grating, giving a dispersion of 1·3 A. per millimetre, every main line in a certain region is found to be accompanied by a weak satellite, and taking the main lines to be due to the molecule Be^9H, the satellites can be shown to be in the positions appropriate to Be^8H. The relative intensities of the Be^8H lines and the Be^9H lines are about 1 to 2000. These results, if substantiated, will confirm Lord Rayleigh's suggestion, which is based on the occurrence of unusually large quantities of helium in the mineral beryl, that a Be^8 nucleus is less unstable than has hitherto been supposed.

Organic Selenium and Tellurium Compounds.—The January number of the *Journal of the Chemical Society* contains two papers by Morgan and Burstall on *cyclo*-selenohexane and *cyclo*-tellurobutane respectively. *Cyclo*-selenohexane, containing Se interposed between two CH_2 groups in *cyclo*-hexane, is a pungent-smelling oil, obtained in small yield by the action of sodium selenide on $\alpha\xi$-hexamethylene dibromide in alcoholic media, the main product being a mixture of at least two polymeric forms. It gives a crystalline mercurichloride, $C_6H_{12}Cl_2SeHg$, a dichloride, a dibromide, a di-iodide, and a methiodide, by direct addition. *Cyclo*-tellurobutane, a five membered ring compound, was obtained by the interaction of tellurium with $\alpha\delta$-tetramethylene di-iodide at 130°, giving the *cyclo*-telluributane di-iodide, which can be reduced to *cyclo*-tellurobutane, a pale yellow oil of repulsive odour which oxidises rapidly in air, the tellurium atom taking up an atom of oxygen. The cyclic tellurohydrocarbon forms very stable dihalides, the chlorine and bromine compounds crystallising unchanged from water. A mercurichloride and a methiodide were also prepared.

Distortion of Flame Surfaces in Electric Fields.—Guénault and Wheeler, in the January number of the *Journal of the Chemical Society*, describe some experiments on the effect of an electric field between two parallel metal plates on the propagation of a carbonic oxide flame initiated at the centre of a spherical bulb. The paper contains some excellent photographs of the flames produced, which show a decided effect of the field. There appears to be little or no alteration in the rate of growth of the flame in a direction transverse to the field. The field did not stimulate the growth of the flame between the plates in the direction in which electrons produced in the flame would be moving, so that such electrons do not appear to assist the propagation of the flame. The speed of the flame was, however, increased in the opposite direction, in which the positive ions are moved. There was also a bodily movement of the whole of the spherical flame surface in the same direction, and sometimes wholly away from the igniting spark. The movement in the opposite direction is, therefore, not only retarded but actually reversed by the field. This suggests that the movement of the flame surface may be mechanical, due to the movement of the heavy positive ions dragging the flame-surface with them, and not necessarily the result of a stimulus to chemical activity imparted by the electric field.

Russian Scientific Workers in Foreign Laboratories.

NEVER before in the history of science has there been a case when hundreds of scientific workers have been exiled wholesale from their country, or have left it because they have found it impossible to continue scientific work there. This is what happened in Russia after the Bolshevist revolution took place about ten years ago; scientific workers, with others, either had to submit to the new régime, with its somewhat unusual views on the subject of the freedom of scientific thought, or to try to seek their fortunes elsewhere. There are no statistics to tell us of the many who left their life's work and their homes behind them, only to fail in their hazardous attempts and to go down in the struggle for existence; but it is of great interest to learn that a large number of them succeeded in finding suitable occupation in various countries and have been able to continue their studies. A good idea of their work can be obtained from the bibliography of books and papers published by Russian scientific workers abroad during the period 1920–1930, issued recently by the Russian Scientific Institute founded in Belgrade with the active support of the Jugoslavian government.*

The volume contains no less than 7032 titles of books and papers published in 18 different languages by 472 Russian authors scattered all over the world, from Sofia to Stockholm, from Kharbin and Indo-China to London and Paris, and from Chicago to Rio de Janeiro. It is natural that the bulk of the titles are those of works on economics, sociology, history, philology, law, and other branches of the humanities, as well as engineering and other applied sciences, but there is an unexpectedly high percentage of works on the natural and exact sciences. Their number is 1929 and they belong to 122 authors. The list is headed by 596 works written by 38 authors on various problems of medicine and physiology, and an important place amongst them belongs to several former pupils of the famous I. Pavlov, whose methods for the study of the physiology of the nervous system are now being developed by them in a number of laboratories in Europe and in the United States. Nine Russian botanists published 121 works, amongst which the books of V. V. Lepeshkin on the chemical physiology of plants are well known to specialists. Exiled geologists number 11, and there are such celebrities amongst them as the late N. I. Andrusov (Prague) and A. Stebutt (Belgrade), the aggregate number of publications on geology reaching 102.

* Materialy dlya bibliographii russkich utchenych trudov za rubezhom (1920–1930). Part 1, pp. 394. Belgrade, 1931.

Ten Russian zoologists and entomologists produced 250 books and papers, including a series of outstanding articles on comparative anatomy by M. M. Novikov (Prague), culminating in the book "Das Prinzip der Analogie und die vergleichende Anatomie" (Jena, 1930). Amongst entomological works, the world catalogue of Aphaniptera by J. N. Wagner (Belgrade) should be mentioned. Microbiologists are only three in number, but the name of S. Metalnikoff (Paris) will be familiar to most specialists in this branch, and the 115 papers produced by them represent a valuable contribution to a number of fundamental problems. Russian chemistry, too, can be justifiably proud of the work of J. I. Bickermann (Berlin) and E. Rabinovitch (Göttingen), to mention only two of the 13 chemists with their 133 publications; while 6 physicists published 101 papers, and 200 papers and books on mathematics and mechanics have been produced by 11 Russian workers. There are only two Russian astronomers abroad, but their names are O. Struve (Chicago) and V. Stratonov (Prague), and they published 100 papers between them. To complete the list, 131 papers and books on geographical subjects written by 11 authors, and 80 publications by 9 authors on agriculture, appeared during the period under review.

Striking though these figures are, they are very incomplete, because the bibliography included only the works of those Russian scientific workers who submitted lists of their papers; many of them failed to do so for various reasons. The editors, however, hope to publish supplements to the bibliography from time to time.

It will be seen that many Russian scientific workers made full use of the opportunities offered them at various universities and laboratories, most of which have gladly opened their doors to their Russian colleagues.

Apart from contributing to the progress of science by their own original work, Russian scientific workers are also doing a great service to men of science of other nations by making available to them the results of Russian researches, which remained largely unknown abroad, by reviewing current and past Russian literature in the respective fields. It would probably not be an exaggeration to say that practically every bibliographical, or abstracting, periodical has now Russian experts on its staff, and this helps to make Russian scientific work available everywhere.

B. P. U.

The Constitution of Soluble Proteins.

THE *Comptes-rendus des travaux du Laboratoire Carlsberg*, vol. 18, No. 5, 1930 (Copenhagen: H. Hagerup, 1930. 6·25 Kr.), contains a long paper (in English) by Prof. Sørensen on recent work on the soluble proteins considered in the light of his theory of reversibly dissociable component systems. According to this, soluble proteins consist of a series of complexes or components, reversibly combined, A_x, B_y, C_z . . ., these components being, for example, mainly polypeptides, but in other cases containing phosphorus, in each of which the atoms are linked by principal valencies, whereas the complexes themselves are held together comparatively loosely and reversibly by residual valencies. The strength and nature of these residual valencies depend on the chemical composition of the component in question as well as on its physical properties—above all on its dimensions and the resulting shape and surface. Alterations in the composition of the solution (salt content, *p*H, alcohol content, temperature) may give rise to reversible dissociation of the component systems and interchange of components between them. When these alterations in composition are so suited as to render possible the formation in sufficient quantities of a component system insoluble or sparingly soluble under the new conditions, such a system will be formed and precipitated.

It is not always easy to determine whether a given protein solution is a mixture or a true component system. Prof. Sørensen shows that the results of his investigations and his theory of reversibly dissociable components are reconcilable with Svedberg's results on the molecular weights of proteins as found by the ultra-centrifuge method. These show that only a few proteins have molecular weights exceeding a million, namely, the haemocyanins of the blood of

some snails. The molecular weights of other proteins are, with one exception (casein, which contains protein molecules of various sizes), small multiples of about 35,000. Egg albumin and Bence Jones's albumin belong to the first group, with spheroidal molecules of radius 22 A. and molecular weight 35,000. Hæmoglobin and serum albumin have non-spheroidal molecules of weight 70,000; serum globulin belongs to the third group, with non-spheroidal molecules of weight 105,000; and the fourth group, with spheroidal molecules of radius 40 A. and weight 210,000, includes the vegetable proteins edestin, excelsin, and amandin. The results for egg albumin, by very different methods, are unanimous, and everything seems to show that it is a simple chemical unit. Serum albumin, on the other hand, has been fractionated. Although the results of Svedberg and Sjögren gave a molecular weight of about 67,500, instead of the value 45,000 found by Sørensen, the latter does not think his product contained true decomposition products, since the fractions retained their marked power of crystallisation. He considers that reversible dissociation only had occurred. He makes a far sharper distinction, in this and other examples, between reversible dissociation and true decomposition of a protein than does Svedberg.

The nature of peptic scission is considered at length, the conclusion being reached that the breaking of peptic linkages is the sole chemical process involved, the simultaneous marked change in physical properties being due to secondary processes (hydration and disaggregation).

The name 'component systems' is now preferred to that of 'co-precipitation systems' introduced by Linderstrøm Lang, the name 'component' being used for an individual reversibly linked constituent. The real character of the molecular weights found by Svedberg is accepted, and the 'average molecular weight' found for a mixture can give valuable information.

In the experimental part, emphasis is laid on the importance of determining the distribution of the components of the dispersion medium between the solution and the undissolved phase, and a number of examples from previous memoirs, as well as new investigations, are summarised in this section. Some tendency to reversible dissociation was detected with egg albumin. Serum albumin was separated into three groups of fractions differing in solubility, irrespective of whether the fraction in question is phosphorus-containing or not. The various fractions differed very little in chemical composition, and two almost identically composed substances may be widely different in solubility, a result which is not due to denaturation. Casein has a very considerable tendency to dissociation, but is not regarded as a mixture. Its ionisability in presence of acid or alkali gives rise to component systems with a much greater dissociating tendency than that of uncharged or isoelectrically charged systems.

The question of protein systems in serum is considered. They are regarded as in continual mutual interaction, forming new systems, the composition of which depends on concentration and other conditions, and the proteins may not correspond with those precipitated by salts. The question which this suggests, whether it is reasonable to retain the old terms serum albumin and serum globulin, is considered, the answer being in the affirmative.

The interesting relation between lipoids and proteins in serum is discussed, particular attention being given to Mâchebœuf's experiments. The latter obtained from horse-serum a product which he regarded as a chemical compound of lecithin, cholesterol ether, and protein, from which lipoids cannot be extracted by ether, and in which the protein is not, or is only slowly, denatured by alcohol at the ordinary temperature. This conclusion is accepted, and it is suggested that the perfect clearness of such liquids as serum and plasma, in spite of their high lipoid content, is explicable only by assuming linkages between the lecithin and sterols on one side and the proteins on the other. The linkage between lipoid and protein is weak and may be split in emulsification processes; a real chemical linkage is not probable.

It will be seen from the above brief summary that Prof. Sørensen's authoritative memoir raises many questions of considerable interest and importance, both from the chemical and the biological points of view, and it may be welcomed as a brief yet comprehensive summary of recent work in that branch of protein investigation to which its author has made so many important contributions.

General Biology in the "Encyclopædia Britannica".

ANY criticism of the articles on general biology in the "Encyclopædia Britannica" must take into consideration, first, the fullness and accuracy of the information contained in them, and secondly, the mode of presentation. For it is surely not sufficient to provide a summary, however authoritative, of any branch of science, if this is presented in such a manner that it cannot be understood by the general reader. It is for his benefit that the "Encyclopædia" is, presumably, issued, and its financial success is certainly dependent upon his willingness to purchase it.

There are some branches of physical science in particular which cannot be presented to the public in an intelligible manner. Both the subject matter and language employed are alien. But this has not in the past been true of biology. Here the general reader has felt confident of understanding articles written about it. It is in some degree a measure of the very definite advance which biology has made in the past generation that the general reader will not infrequently find these biological articles difficult of comprehension. But the fault does not always lie solely in the subject matter, for several of the authors have shirked the admittedly difficult task of presenting their information in plain English and taken the easier way of scientific 'shorthand'. The more intricate biology becomes, the greater the need for clear writing in articles such as these.

It is pleasant to find, therefore, that the articles which will probably be most frequently consulted by the general reader, evolution by Prof. E. S. Goodrich and zoology by Prof. D. M. S. Watson, are wholly admirable in both their scope and presentation. No biologist can read them without having his ideas clarified, and no layman can fail to understand them or to be impressed by the range of knowledge they display. The only criticism we have concerns the article on evolution. Here the vital need, in Darwin's opinion, of natural selection as the mechanism which prevented the swamping, as he thought, of any favourable variation by promiscuous interbreeding, is not stated. The reader is left with the impression that Darwin realised, as his successors do to-day, that there was such a thing as segregation which makes swamping impossible.

Prof. J. B. S. Haldane has made the best of a very difficult task in his article on heredity. It is not easy reading, but, in view of the nature of the facts with which it deals, this could not be avoided, and the

reader who takes the trouble to work his way slowly and carefully through this article will be repaid by the acquisition of a clear idea of the present state of knowledge on this subject, and also with a respectful feeling that biology *is* developing into an exact science. The article is a thorough-going account of the modern developments of Mendelism, but, with all possible respect to the work which it summarises, one is left with a feeling of the immensity of the superstructure which is now borne on the shoulders of the chromosome theory, and with a doubt as to whether some future edition of the "Encyclopædia" may not contain accounts of underlying principles of heredity as yet unsuspected.

Prof. F. A. E. Crew also provides an excellent summary of modern knowledge on sex, but, with somewhat more tractable material at his disposal, he is not quite so successful in his presentation. By some oversight, his long article contains no illustrative diagrams or graphs. It is doubtful whether the general reader, however painstaking, will really acquire a clear idea of the subject from this article, but to the biologist it can be recommended as a masterly summary of the facts.

Two articles, one on ecology by Mr. C. S. Elton and the other on experimental embryology by Mr. G. R. de Beer, bear testimony to the development of work on these subjects of recent years. The general reader will find Mr. de Beer's article full of surprising and unexpected information, and few biologists, outside the limited number who work on this subject, will fail to profit by the reading of it. Mr. Elton's article is interesting and well written but rather surprisingly long—the result, not of excess of knowledge, but of too little and a consequent lack of summarising generalisations. But it is a little difficult to understand why this article should be so long, when Prof. C. Lloyd Morgan is so restricted in his article on animal behaviour that his statements are condensed almost to the point of being unintelligible.

Prof. J. S. Huxley gives most interesting and well-written accounts of the courtship of animals and of sexual selection, and Sir J. Arthur Thomson is equally successful in his treatment of parasitism. Indeed, all the articles on what might best be described as natural history are excellent.

In his article on marine biology, Prof. J. Johnstone has largely confined himself to a clear but very general account of the different zones and conditions of life in the sea. The general reader is unfortunately left largely in ignorance of some of the recent advances in this subject, notably on the factors which control the abundance of the plankton and its variations throughout the year and in different regions.

It remains only to mention the articles on special groups of the animal kingdom, three of which, on protozoa, sponges, and tunicata, have been examined. The information therein contained is as concise and authoritative as the names of the respective authors, Dr. K. Bělař, Dr. G. P. Bidder, and Prof. W. Garstang, would lead us to expect. They all, in greater or less measure, give an account of the functioning of the animals, as well as of their structure and systematics, and so bear witness to the slow but ever-increasing accumulation of knowledge which, as Prof. Watson states in his article on zoology, is gradually building up a science of comparative physiology, of which, it may safely be prophesied, the next edition of this great "Encyclopædia" will have much to say.

Fuel Research in Great Britain.

THE Report of the Fuel Research Board for the year ending Mar. 31, 1930 (London: H.M.S.O., 1930; 2*s*. net), is an interesting document, because it seems to touch upon almost every technical problem of fuel in the British Isles.

One of the original plans of the Board was the prosecution of a survey of the national coal resources. The report shows that the recent establishment of a laboratory at the University of Leeds to study the West Yorkshire coalfield brings under survey areas producing 96 per cent of the coal raised, and the remaining 4 per cent can be handled by the existing organisation. The value of this work will be increasingly recognised as time goes on. One example is given in the report, namely, the publication of a hasty survey of Scottish coals made during the War, when the need arose to increase the production of furnace coke in Scotland, and it was found that the data had to be sought as an emergency measure.

The report gives a survey of the position of low temperature carbonisation, leading to the conclusion that its true place in the carbonisation industries cannot yet be defined, although several processes are being worked on a considerable scale and making good solid fuel products. The world prices for oil fuels have fallen so much recently as to make the economic position of these processes worse. Motor spirit is the most valuable by-product; but the yields of this are usually small, and the most hopeful line appears to be the conversion of a larger portion of the tar into this product. The tars themselves have such a character that they are largely inapplicable for the purposes to which tars are normally used. In order to find a basis for exploitation, their chemistry is being studied at the Chemical Research Laboratory, Teddington. Two methods are suggested for promoting the utilisation of tar. The first is the use of 'cracking', following the practice of the petroleum industry; but the tendency to form large quantities of coke and gas is unfavourable to the use of these tars as 'cracking stock'. Alternatively, the tars may be hydrogenated under pressure, which may be regarded as a form of 'cracking' in which coke formation is prevented by the union of hydrogen with the fragments. Very interesting experiments in this direction are recorded. By means of controlled hydrogenation, it has been possible to convert nearly the whole of a low temperature tar into motor spirit and neutral oil—the yields of the former working out at 16 gallons per ton of coal carbonised. The Admiralty staff has also examined the possibility of using low temperature tar oil as fuel for steam raising and for Diesel engines, with encouraging results.

The hydrogenation of coal and its products is obviously a subject of great potential importance nationally and to the coal industry. Though much has been done by private interests, the amount of authentic published experience is not great. The report describes the results of experiments—both static and continuous—on the hydrogenation of coal. With the use of suitable catalysts, it is found that Continental experience can be repeated with British coals and satisfactory yields of oil obtained. The character of the product is such that its after-treatment is difficult. A modification of the process, in which the coal is treated with a rapid stream of preheated hydrogen, has shown that much better products can thus be obtained. Indeed, it is stated that yields of motor spirit up to 120-130 gallons per ton of coal could be realised in a suitable plant. Another interesting scientific observation is the possibility of converting non-coking coal into coking coal by partial hydrogenation.

Much is hoped from the use of pulverised fuel as a

means of promoting the use of coal on board ship. In land practice, coal-dust firing has been made possible by the use of large combustion chambers; but at sea this is impossible. In essence, the problem is to bring air for combustion into contact with finely divided suspended particles—a problem in aerodynamics which is being systematically studied. By attention to these requirements very high rates of heat release in small burners have been obtained, which should contribute to the solution of this problem.

The staff of the Board has carried out laboratory work on the properties of coal, and also supported investigations by independent workers in the universities and elsewhere who have originated special techniques. Thus Mr. C. A. Seyler has been enabled to develop methods for studying polished surfaces of coal by reflected light. His work has recently been published as a special report. Mr. Lomax is studying the distribution of spores in coal seams by examination of their sections. This work, in association with that of the South Yorkshire Survey Laboratory, suggests the possibility of identifying and correlating seams by identification of the spores contained. Interesting work in association with the Building Research Station is reported which should place the calculation of the heat requirements of buildings on a quantitative basis.

In conclusion it may be said that the report comments on so many points that the reader can gather from it a very good idea of the status of British fuel problems in general. H. J. HODSMAN.

University and Educational Intelligence.

CAMBRIDGE.—In a report of the Council of the Senate on the future of mineralogy, petrology, and crystallography in the University it is recommended that, upon the retirement of Prof. A. Hutchinson from the professorship of mineralogy, the professorship of mineralogy be discontinued, and that there should be established in the University a professorship of mineralogy and petrology, assigned to the Faculty of Biology "A", and that a department of the same title be constituted, to include also the subject of crystallography.

The Council of the Senate recommends that the Downing professorship of medicine be discontinued.

Mr. H. H. Brindley, University demonstrator in zoology, has been elected to a fellowship at St. John's College.

LEEDS.—Courses of lectures on literary and scientific subjects will be given in the University during the Easter vacation, on April 15, 16, and 17, 1931. The lectures are intended primarily to meet the needs of those who find it difficult to keep in close touch with recent developments, and will also give opportunities for discussion. Graduates of the University of Leeds will be admitted free, but for others a fee of £1 will be charged. The science courses include lectures on the electronic theory of valency and on modern views on colloids, acids and bases, and the ionisation of electrolytes, and on the relationship between philosophy and various aspects of natural science. Applications for admission to the course should be sent not later than Mar. 21 to The Registrar, the University, Leeds, and should be accompanied by a remittance where payable.

LONDON.—Mr. W. B. R. King has been appointed as from Aug. 1 next to the Yates-Goldsmid chair of geology tenable at University College. Since 1922 he has been fellow and Charles Kingsley lecturer at Magdalene College, Cambridge.

A University (part-time) chair of medical psychology tenable at the London School of Hygiene and Tropical Medicine is to be instituted.

ST. ANDREWS.—The Court has approved generally plans prepared by Mr. J. D. Mills for a new building to provide accommodation for the departments of botany and geology at St. Andrews, to be erected adjoining the group of buildings presently occupied by the Bute Medical School and the Bell-Pettigrew Museum. Plans have also been approved for the adaptation of Deanscourt, St. Andrews, as an additional residence hall for men students.

Dr. W. F. Harper, hitherto assistant in anatomy, has been appointed a lecturer in regional anatomy in the University.

THE American University Union (British Division), which has recently moved its London office from Russell Square to 1 Gordon Square, W.C.1, announces, in a leaflet entitled "14 Points", the nature of the service it offers to American students and to British university graduates and others interested in American universities. It facilitates meetings of British scholars with Americans; supplies, upon request from British societies, American college lecturers upon American subjects; and keeps a register of applicants for university posts in the United States. Through the Institute of International Education (2 W. 45th Street, New York), which publishes a monthly *Bulletin*, it undertakes arrangements for exchange professorships, visiting professorships, and exchange scholarships between British and American colleges. It maintains personal touch, by visits, with each of the universities in Great Britain and Ireland, and tells them of the ways and aims of education in America. It keeps on file the latest calendars of all representative American colleges, and answers questions about them, put by British educational authorities. It co-operates with the Continental Division of the Union (173 Boulevard St. Germain, Paris) in the endeavour to help visiting scholars to acquaintanceships in any educational centre in Europe. The director is W. Connely.

UNIVERSITY education in India is briefly discussed in the official pamphlet, "Education in India, 1927–1928", recently published (Calcutta: Gov. India Cent. Pub. Branch, 1.12 rupees). The rate of increase in the number of students in universities and arts and professional colleges (0·8 per cent of the total number of scholars in all kinds of institutions) is recorded as 0·84 per cent in twelve months, during which time the total of scholars of all kinds increased by 5·5 per cent. Expenditure on university and collegiate education, which is 13 per cent of the total expenditure on education, increased at the rate of 7 per cent, as compared with an increase of 5 per cent in the total expenditure on education of all kinds. The Indian Institute of Science, Bangalore, with its 100 students, accounts for 1·5 per cent of the expenditure on university and collegiate education. Of four of the seventeen universities—Allahabad, Andhra, Lucknow, and Madras—it is recorded that they have adopted the principle of compulsory physical training for their students. There are two religious denominational universities, the Aligarh Muslim and the Benares Hindu. To each of them the United Provinces Government gave a recurring grant of 50,000 rupees to enable them to maintain departments of, respectively, Unani and Ayurvedic medicine. In another direction the Benares Hindu University has broken away from the traditions of Indian universities by providing advanced courses which prepare for industrial life, and its diploma in engineering is recognised by employers as a guarantee of a sound training in mechanical and electrical engineering.

Birthdays and Research Centres.

Mar. 8, 1855.—Prof. K. E. VON GOEBEL, For.Mem.R.S., professor of botany in the University and Director of the Botanical Gardens, Munich.

At present I am engaged on the preparation of a work on "The Flowering Shoot" (anthocladia and inflorescences) to be published this year as the second supplement to the "Organographie den Pflanzen", third edition. My main interest is the biology and taxonomy of leptosporangiate ferns.

A critical revision of phylogeny, especially a comparison of the results of the phyto-palæontological discoveries with the modern views on the relationships in the larger natural groups of plants, for example, in ferns, is a problem deserving of the closest study.

Mar. 9, 1862.—Sir SIDNEY F. HARMER, K.B.E., F.R.S., formerly Director of the Natural History Departments of the British Museum.

My principal work, at present, is the preparation of Part 3 of my *Report* on the Polyzoa collected by the *Siboga* in the Malay Archipelago.

I continue to keep in touch with recent developments of the subantarctic whaling industry. Whaling operations have increased in magnitude to an alarming extent, particularly since the season 1926–27, and principally as the result of the increased use of pelagic 'floating factories' which operate on the high seas. These ships, which have already reached a size exceeding 20,000 tons, are capable of performing all manufacturing operations on board. They are under no effective control, and there is reason to believe that in some cases a regrettable waste of valuable material is taking place. The production of oil, in these localities, has risen from less than 800,000 barrels in 1925–26 to more than 1,600,000 barrels in 1928–29, and more than 2,500,000 barrels in 1929–30 (6 barrels = 1 ton). Naturalists acquainted with the results of earlier hunting in other areas are convinced that the whale population of subantarctic seas, the last refuge of the great whales, will be gravely reduced, in the near future, unless it is found possible to secure international agreement to the regulation of the industry, on satisfactory lines.

Mar. 13, 1873.—Dr. CHARLES S. MYERS, C.B.E., F.R.S., Director of the National Institute of Industrial Psychology.

Much of the research work on which my staff and I have been engaged during the past ten years at the National Institute of Industrial Psychology has been fundamentally concerned with the mental differences between individuals. Undoubtedly it suggests a problem of vast magnitude for future solution, namely, what are the *physiological* differences with which these *mental* differences are associated? What, for example, is the physiological significance of the discovery that, during the menstrual period, the mental efficiency of some women is distinctly greater, in others less, while in many it is not appreciably changed, compared with other times? What, again, is the physiological significance of similarly wide individual differences in efficiency which appear to result from ultra-violet radiation? And what is the physiological significance of the striking differences in various mental characteristics revealed by mental tests?

Clearly, conjoint physiological and psychological research is essential to ascertain what *bodily* differences, say in metabolism, blood composition, or endocrine activity, are responsible for the *mental* differences disclosed by the Institute's research work.

Societies and Academies.

LONDON.

Royal Society, Feb. 26.—J. C. Eccles and Sir Charles Sherrington: Studies on the flexor reflex. (1) Latent period. A method for measuring the latent period of the flexor reflex is described. The values obtained for the central reflex time range from $2{\cdot}7\,\sigma$ to $4{\cdot}35\,\sigma$, and are in general agreement with the values calculated by Jolly and by Forbes and Gregg. The central reflex time is shortened when the stimulus applied to the afferent nerve is strengthened. The temporal dispersion of many reflex discharges is shown to be due, not to the discharge of more than one impulse from motoneurones, but to variations in the latent periods of the single responses of different motoneurones. The latent period of the response to a centripetal volley is greatly shortened if another volley precedes it by certain intervals. This shortening occurs at the expense of the central reflex time. It is concluded that all the time is saved in the reduction of the normal 'synaptic' delay by facilitation. If that is so, the actual conduction time through the spinal cord must be less than $0{\cdot}5\,\sigma$. On the assumption that the normal 'synaptic' delay is due to time taken for a succession of excitatory impulses (owing to their temporal dispersion) to build up a c.e.s. of threshold intensity, all the observations are satisfactorily explained. The experiments support the conclusions that in the flexor reflex, centripetal impulses are not transmitted straight through the spinal cord, but at certain points ('synapses') they are transformed into an enduring excitatory condition, c.e.s., which may in turn set up fresh nerve impulses—the reflex discharge.—(2) The reflex response evoked by two centripetal volleys. When the interval between two centripetal volleys is short, the reflex contraction evoked by the second volley is due largely to the discharge of motoneurones which fail to respond to either volley alone. The response of these motoneurones is due to summation of the subliminal excitatory effects of each volley. In addition to this facilitation at short intervals, a centripetal volley gives rise to a period of unresponsiveness of motoneurones. Three types of unresponsiveness have been met with: (*a*) Recovery complete in less than $16\,\sigma$. (*b*) Recovery complete in less than $50\,\sigma$. (*c*) Recovery not complete for more than $80\,\sigma$. From theoretical considerations, the duration of the relatively refractory period following an antidromic volley ($10{\cdot}5\,\sigma$) is likely to be identical with the duration of the relatively refractory period of the reflex arc.—J. C. Eccles: Studies on the flexor reflex. (3) The central effects produced by an antidromic volley. When a single stimulus is applied to an intact motor nerve, a volley of impulses (called an antidromic volley) passes into the spinal cord through the ventral roots. A single centripetal volley gives rise to c.e.s. during a considerable period. Persistence of the c.e.s. set up by such a volley is due partly to the temporal dispersion of the incident excitatory impulses and partly to the c.e.s. produced by any particular impulse itself enduring for some time. In any motoneurone an antidromic impulse removes preformed c.e.s.—J. C. Eccles and Sir Charles Sherrington: (4) After-discharge. A period of quiescence follows an antidromic volley set up during the after-discharge of a reflex either by a single centripetal volley or by a repetitive series of centripetal volleys (confirming Denny-Brown). It is concluded that preformed c.e.s. of a motoneurone is removed by a reflex discharge, and has to be built up again by delayed excitatory impulses before another discharge can occur.—J. C. Eccles and Sir Charles Sherrington: (5) General

conclusions. A brief statement with discussion of various views of the nature of central excitation in reflex activity.—A. V. Hill and J. L. Parkinson: Heat and osmotic change in muscular contraction without lactic acid formation. Frogs' muscles poisoned with iodo-acetic acid, in which no lactic acid is formed, when stimulated to exhaustion in nitrogen gave total heat 0·367 cal. per 1 gm. and showed a rise of osmotic pressure. This change of osmotic pressure cannot be explained in full without assuming either (*a*) that some chemical reaction, hitherto unrecognised, occurs in such poisoned muscles when stimulated, or (*b*) that phosphagen (and perhaps adenyl-pyrophosphoric acid) exist not as simple molecules in the resting muscle but in some combined form.

Society of Public Analysts, Feb. 4.—L. H. Lampitt and J. H. Bushill: The solubility of milk powder—the moisture factor. The authors stress the complicated nature of the changes which take place when spray-dried milk powder absorbs moisture. The freezing of the fat, whereby it is made available for solution in organic fat solvents, is one indication of the changes taking place above the 'critical moisture content', a figure dependent upon the solids not fat.—S. Marks and R. S. Morrell: (1) The determination of the hydroxyl content of organic compounds: estimation of castor oil. Peterson and West's modification of the method of Verley and Bolsing, in which the hydroxyl content is determined by treatment with acetic anhydride and pyridine, was found the most satisfactory method, and is particularly suitable for the estimation of castor oil.—(2) The determination of the carboxyl and aldehyde content of organic compounds: estimation of phenylhydrazine. The most suitable method was found to be that of Ellis, in which the substance is treated with excess of phenylhydrazine, and the nitrogen evolved on treating the excess with Fehling's solution is collected and measured in a simple form of apparatus, an allowance being made for the benzene vapour.—A. Van Raalte and J. Straub: Food control in Holland. Food control in Holland is based on legal standards arrived at usually by agreement between the directors of the control service and the large manufacturers. Not only foods, but also other commercial products such as toilet articles, wallpaper, insecticides, etc., are subject to control. There is a right of inspection of premises where food is manufactured or sold, and this, coupled with intensive sampling, has reduced to 6·7 per cent, the percentage of samples falling below the standard.—H. R. Ambler: The determination of small quantities of methane. The hydrogen and carbon monoxide are oxidised by means of cupric oxide at about 500° C., the resulting carbon dioxide removed, and the methane determined by burning with oxygen in the presence of platinum wire at bright yellow heat, and measuring the carbon dioxide produced and the residual oxygen.—R. Bhattacharya and T. P. Hilditch: The fatty acids and component glycerides of Indian ghee. Cow ghee gives figures falling within the limits previously recorded for English and New Zealand butter fats, but buffalo ghee showed rather higher Reichert-Meissl and Kirschner values. It also contained more butyric and stearic acids than cows' butter.

Geological Society, Feb. 11.—W. J. Arkell: The Upper Great Oolite, Bradford Beds, and Forest Marble of South Oxfordshire, and the succession of gastropod faunas in the Great Oolite. In the first part of the paper the principal exposures in South Oxfordshire of the uppermost beds of the Great Oolite and the Forest Marbles are described, with especial reference to the palæontological horizons, and for the first time the fauna of the highest portion (or Block I.) of the Great Oolite is enumerated and discussed. It is shown that this fauna is essentially a Great Oolite one. Secondly, it is demonstrated that the renowned fossil bed of Islip contains nearly the whole of the highly characteristic assemblage of the Bradford Clay, of which it is held to be a true representative. In the second part of the paper the gastropod beds of the Great Oolite are studied, and an attempt is made to disentangle the various species and genera.—A. Heard and J. F. Jones: A new plant (*Thallomia*), showing structure, from the Downtonian Rocks of Llandovery, Carmarthenshire. The structures of the peculiar fossil were revealed by mechanical and chemical methods of treatment. Horizon: Lower Downtonian, probably a few yards above the Upper Ludlow—Downtonian junction. Locality: Long. west 3° 41′, lat. north 51° 58′ 35″.

PARIS.

Academy of Sciences, Jan. 5.—Auguste Lumière and Mme. A. Dubois: The distribution of Koch's bacilli, contained in milk, after separating the butter and casein. Known amounts of tubercle bacillus were added to milk, the cream separated, and the casein separated from the butter-milk in the usual way. The resulting whey and the cream were free from bacilli, which appear to be concentrated in the casein. It is concluded that starting with tuberculous milk the maximum danger is in the cheese.—J. Herbrand: The units of an algebraical body.—J. Rey Pastor: A characteristic property of the varieties of Jordan.—H. F. Bohnenblust and E. Hille: The absolute convergence of Dirichlet's series.—L. Tchakaloff: The theorem of finite increments.—Georges Bouligand: Cavities arising in a heavy liquid.—G. Ribaud and P. Mohr: The determination of the melting point of platinum. The method adopted was optical extrapolation, starting with the melting point of gold. The melting point found was 1762° ± 2° C.—Mlle. M. Chenot: A new appearance of the high frequency discharge.—G. Ferrié: Remarks on the preceding communication.—Armand de Gramont: Transmitted light in the case of so-called total reflection. If a light pencil is reflected from the long side of a right-angle prism, under an angle of incidence greater than the limiting angle, some light diffuses through the back of the prism and shows a maximum in a definite direction. The intensity of this maximum depends on the polish of the reflecting surface.—Jean Loiseleur and Léon Velluz: The preparation of cellulose membranes containing proteins. The solubility of some proteins (gelatine, casein, egg albumen) in anhydrous organic acids allows the preparation of true solutions of mixtures of proteins and cellulose derivatives, and from these, by evaporation, membranes of varying permeability can be prepared.—P. Pingault: The iron carbide and iron oxygen equilibrium.—L. Hackspill, A. P. Rollet, and L. Andrès: The action of boric acid upon the alkaline chlorides and nitrates. In the presence of steam, boric acid easily displaces the acid of alkaline chlorides and nitrates.—M. Lemarchands and C. Tranchat: The purification of disodium phosphate.—A. Travers and Avenet: The determination of thiocyanates in coke oven effluents. The thiocyanate is precipitated as cuprous thiocyanate, this dissolved in ammonia, oxidised to cupric salt, and titrated with potassium permanganate.—Mme. Ramart-Lucas and J. Hoch: The absorption spectra of dibenzyl and its derivatives. A band attributed by previous workers to dibenzyl has been found to be due to the presence of a trace of stilbene as impurity.—A. Marin and P. Fallot: The distribution of the facies in the Spanish Rif and their special character.—Pierre Dangeard: A parasitic *Ectocarpus* causing tumours in *Laminaria flexicaulis*

(*Ectocarpus deformans*).—**Robert Weill**: The genus *Pteroclava*, the systematic interpretation of the Pteronemidæ and the taxonomic value of the cnidome.—**Georges Fontès** and **Lucien Thivolle**: Tryptophane and histidine are anabolites. The simultaneous injection of tryptophane and histidine into dogs, in equilibrium with a fixed food ration, results in rapid gains in weight, and these gains are maintained for some time.—**L. Septilici**: The diagnosis of syphilis by spectroreaction.—**C. Levaditi** and **P. Lépine**: The preventive action of liposoluble bismuth in experimental syphilis of the chimpanzee.

Jan. 12.—**A. Guldberg**: The problem of the scheme of urns.—**David Wolkowitsch**: The geometrical properties of ellipses of inertia of a plane system.—**J. A. Lappo-Danilevski**: The analytical coefficient of the singularities of integrals of systems of linear differential equations with arbitrary rational coefficients.—**N. Mouskhelichvili**: New method of reduction of the fundamental biharmonic problem to an equation of Fredholm.—**J. Dieudonné**: The radius of univalence of polynomials.—**O. Nikodym**: Linear and continued functionals.—**J. Dufay** and **R. Gindre**: The variable star *d*-Cygni. The variations of luminosity suggest the mutual eclipses of two stars moving in circular orbits and give a curve of the type of β-Lyrae. A detailed spectroscopic study is required to elucidate the physical nature of the system of *d*-Cygni.—**Jean Ullmo**: The application of classical statistical conceptions to wave mechanics.—**H. Muraour** and **G. Aunis**: The variation of $\int p\,.\,dt$ with density of the charge for different types of (explosive) powders.—**Charles Marie** and **N. Marinesco**: The phenomena of adsorption and protection in complex colloidal media.—**Augustin Boutaric** and **Jean Bouchard**: The acceleration produced by light in the flocculation of colloidal solutions in fluorescent media. Suspensions of gamboge and resin (in presence of eosin and fluorescin) and of arsenic sulphide sols (in presence of eosin, fluorescin, and erythrosin) were used. It was generally found that flocculation is accelerated by light: in the absence of the fluorescent substance the flocculation was not accelerated.—**G. Chaudron** and **A. Girard**: The formation of a ferromagnetic iron sesquioxide by the decomposition of van Bemmelen's hydrated sesquioxide.—**V. Agafonoff**: The influence of impurities on some physical and crystallographic properties of hemimellitic acid. Some anomalies in crystal form and optical properties were traced to the presence of impurities, one being calcium hemimellate.—**V. Gouzien**: The geological structure of the peninsula of Crozen (Finistère).—**M. Gignoux** and **E. Raguin**: The stratigraphy of the Trias of the Briançonnais zone.—**Ch. Poisson** and **J. Delpeut**: Magnetic observations at Tananarive.—**L. Mercier**: The hypopleural bristles of *Orygma luctuosa* and the principle of the connexion of the organs.—**Mme. Lucie Randoin** and **Mlle. Andrée Michaux**: Variations in the proportions of chlorine and of water in striated muscle, liver, and kidneys in the course of acute experimental scurvy. At the time of appearance of the characteristic symptoms of scurvy, the proportion of chlorine in the muscles shows marked increase, from 0·5 per thousand to twice or even three times this amount, and this is due essentially to the deficiency in vitamin C.—**Raymond-Hamet**: The cardiac antagonism of pilocarpine and tropine.—**Jean Régnier** and **Guillaume Valette**: The influence of the concentration of hydrogen ions on the fixation of cocaine by adsorption on the nerve fibres. The experiments described lend support to the hypothesis according to which increasing alkalinity increases the anæsthetic action of cocaine hydrochloride, not only by modifying the physico-chemical properties of the anæsthetic solution in a sense favouring fixation, but also by reinforcing the power of fixation of the nerve cell itself.—**P. Delanoë**: The sensibility of the fox to the Moroccan spirochæte, *Sp. hispanicum* var. *marocanum*. Young foxes are frequently infected, but as adult foxes can show a very complete acquired immunity, the fox, like the porcupine, must be regarded as a reservoir of the virus.

Official Publications Received.

BRITISH.

The British Electrical and Allied Industries Research Association (Incorporated). Tenth Annual Report, October 1, 1929, to September 30, 1930. Pp. 86. (London.)

The Journal of Physiology. Subject Index to Volumes 1 to 60. Pp. iv+201. (London: Cambridge University Press.) 15*s*. net.

Navy (Health). Statistical Report of the Health of the Navy for the Year 1929. Pp. 153. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

War Office. Report on the Health of the Army for the Year 1929. (Vol. 65.) Pp. iv+172. (London: H.M. Stationery Office.) 3*s*. net.

Canada. Department of Mines: Mines Branch. The Salt Industry of Canada. By L. Heber Cole. (No. 716.) Pp. viii+116+15 plates. (Ottawa: F. A. Acland.) 20 cents.

The Engineer Directory and Buyers Guide, 1931. Pp. 260. (London.)

Proceedings of the Cambridge Philosophical Society. Vol. 27, Part 1, January. Pp. 162. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

The Journal of the National Institute of Agricultural Botany. Vol. 2, No. 4. Pp. 309-412. (Cambridge: W. Heffer and Sons, Ltd.) 2*s*. 6*d*.

Proceedings of the Royal Irish Academy. Vol. 39, Section B, No. 28: A Statistical Analysis of the Laws governing the Urea Excretion in Man. By Dr. E. J. Conway. Pp. 574-594. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

C.B.C. Bulletin No. 2: Coital Interlocking, a Physiological Discovery. By Dr. Marie Carmichael Stopes. Pp. 6. (London: Mothers' Clinic for Constructive Birth Control.)

Nigerian Forestry Department. Bulletin No. 1: Record of Forest Research in 1928. Pp. 42. (Lagos: C.M.S. Bookshop; London: The Crown Agents for the Colonies.) 5*s*.

Journal of the Chemical Society. January. Pp. iii + 223 + x. (London.)

Some Notes on the Cinchona Industry. (Streatfeild Memorial Lecture, 1930.) By Bernard F. Howard. Pp. 22+4 plates. (London: Institute of Chemistry.)

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 25, 1929, No. 2: Numismatic Supplement for 1929. Pp. 78+5 plates. (Calcutta.)

The Journal of the Botanical Society of South Africa. Edited by R. H. Compton. Part 16. Pp. 30+3 plates. (Kirstenbosch.)

Quarterly Journal of the Royal Meteorological Society. Vol. 57, No. 238, January. Pp. 116. (London: Edward Stanford, Ltd.) 7*s*. 6*d*.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930. Vol. 42, January. Pp. 959-1044+xl. (London.)

Memoirs of the Indian Meteorological Department. Vol. 25, Part 6: The Wind at Agra and its Structure. By Barkat Ali. Pp. 191-251+6 plates. 2.14 rupees; 5*s*. Scientific Notes. Vol. 2, No. 17: Tables of Monthly Average Frequencies of Surface and Upper Winds up to 3 Km. in India, Part A. Pp. 64-127. 1.6 rupees; 2*s*. 3*d*. Vol. 2, No. 17: Tables of Monthly Average Frequencies of Surface and Upper Winds up to 3 Km. in India, Part B. Pp. 129-192. 1.6 rupees; 2*s*. 3*d*. Vol. 3, No. 18: The Structure of the Madras Storm of January 1929. By Dr. K. R. Ramanathan and A. A. Narayana Iyer. Pp. 12+11 plates. 1.10 rupees; 2*s*. 6*d*. Vol. 3, No. 19: Distribution of Air Density at M.S.L. over India. By U. N. Ghosh. Pp. 13-14+20 plates. 1.4 rupees; 2*s*. (Calcutta: Government of India Central Publication Branch.)

FOREIGN.

Scientific Survey of Porto Rico and the Virgin Islands. Vol. 6, Part 4: Botany of Porto Rico and the Virgin Islands. Supplement to Descriptive Flora, Spermatophyta, Bibliography, Spermatophyta and Pteridophyta, Index to Volumes 5 and 6. By N. L. Britton and Percy Wilson. Pp. 521-663. 2 dollars. Vol. 10, Part 4: The Ascidians of Porto Rico and the Virgin Islands. By Willard G. Van Name. Pp. 401-535. 2 dollars. Vol. 12, Part 1: Insects of Porto Rico and the Virgin Islands. Heterocera or Moths (excepting the Noctuidæ, Geometridæ and Pyralididæ). By W. T. M. Forbes. Pp. 174. 2 dollars. (New York: New York Academy of Sciences.)

Meddelelser fra Kommissionen for Havundersøgelser. Serie Hydrografi, Bind 2, No. 10: Contributions to the Hydrography of the Waters round Greenland in the Year 1925. By Baggesgaard-Rasmussen and J. P. Jacobsen. Pp. 24. (København: C. A. Reitzels Forlag.)

Koninklijk Nederlandsch Meteorologisch Instituut, No. 102. Mededeelingen en Verhandelingen, 29c: Klimatologie van den Indischen Oceaan. v. Neerslag; vi. Frequentie van Luchtdrukkingen en Stormachtige Winden; vii. Tropische Cyclonen. Door P. H. Gallé. Pp. 31. (Amsterdam: Seyffardt's Boekhandel.) 0.45 f.

Proceedings of the Imperial Academy. Vol. 6, No. 9, November. Pp. xxvii-xxviii+357-384. (Tokyo.)

Science Reports of the Tokyo Bunrika Daigaku. Section B, Nos. 2-5. No. 2: On Vector Quantity, 1: A Method of Vector Analysis with an Idea of Higher Complex Numbers, by Sumiyosuke Ono; No. 3: On the Expression of the Transition Probability, by Uzumi Doi; No. 4: Large Displacements in the Spectra of Ionized Nitrogen, by Kwan-ichi Asagoe; No. 5: Some Peculiar Types of the Lichtenberg Figures, by Kwai Umeda and Mitsuo Shoyama. Pp. 15-66+4 plates. (Tokyo: Maruzen Co., Ltd.) 75 sen.

Meddelande från Lunds Astronomiska Observatorium. Ser. 2, Nr. 56: Stars with large Proper-Motions in the A.G. Zone of Lund (0^h-12^h). By W. Gyllenberg. Pp. 17. (Lund: C. W. K. Gleerup.)

Memoirs of the Faculty of Science and Engineering, Waseda University, Tokyo, Japan. No. 7, 1930: The Collection of the Abridged Reports during 1927–1930 from Technical Chemical Laboratory, Waseda University. Pp. v+146. (Tokyo.)

The University of Colorado Studies. Vol. 18, No. 2: Abstracts of Theses for Higher Degrees, 1930. (University of Colorado Bulletin, Vol. 30, No. 11: General Series No. 286.) Pp. 43-118. (Boulder, Colo.)

Proceedings of the California Academy of Science, Fourth Series. Vol. 19, No. 11: Marine Algæ of the Revillagigedo Islands Expedition in 1925. By William Albert Setchell and Nathaniel Lyon Gardner. Pp. 109-215 (plates 4-15). (San Francisco, Calif.) 1.50 dollars.

Proceedings of the United States National Museum. Vol. 77, Art. 17: Studies of the North American Weevils belonging to the Superfamily Platystomoidea. By W. Dwight Pierce. (No. 2840.) Pp. 34+5 plates. Vol. 78, Art. 10: A Revision of the North American Tachinid Flies of the Genus Achaetoneura. By R. T. Webber. (No. 2853.) Pp. 37. (Washington, D.C.: Government Printing Office.)

United States Department of the Interior: Office of Education. Bulletin, 1930, No. 19: Accredited Higher Institutions, 1929–1930. By Ella B. Ratcliffe. Pp. v+156. (Washington, D.C.: Government Printing Office.) 20 cents.

University of Illinois Engineering Experiment Station. Bulletin No. 213: Combustion Tests with Illinois Coals, conducted by the Engineering Experiment Station, University of Illinois, in coöperation with the Zeigler Coal and Coke Company. By Prof. Alonzo P. Kratz and Wilbur J. Woodruff. Pp. 58. 30 cents. Bulletin No. 214: The Effect of Furnace Gases on the Quality of Enamels for Sheet Steel; a Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in coöperation with the Utilities Research Commission. By Prof. Andrew I. Andrews and Emanuel A. Hertzell. Pp. 29. 20 cents. Bulletin No. 216: Embrittlement in Boilers; a Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in coöperation with the Utilities Research Commission. By Prof. Frederick G. Straub. Pp. 125. 65 cents. (Urbana, Ill.)

CATALOGUES.

English Literature, including First and Early editions, Association Books, Autograph Letters, etc. (Catalogue 360.) Pp. 98. (Cambridge: W. Heffer and Sons, Ltd.)

Catalogue of Important Books on Botany, Horticulture, Zoology and Geology. (No. 15.) Pp. 16. (London: John H. Knowles.)

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 16) Pp. 503-580. (Paris: Libr. Adrien-Maisonneuve.)

Colorimeters. (List No. 92.) Pp. 24. Microscopes and Accessories. (List No. 91.) Pp. 56. Electro-chemical Apparatus, embodying Electro Analysis of Metals, Electrometric Determination of Hydrogen Ions, and Conductivity of Electrolytes. (List No. 80c.) Pp. 44. (London: A. Gallenkamp and Co., Ltd.)

The Products and Aims of the Firm of Adam Hilger, Ltd. Pp. 33. The Cubic Crystal Analyser. (S.B. 136.) Pp. 7. Hilger X-Ray Crystallograph for the Analysis of Substances having Crystalline Structures. Pp. 10. (London: Adam Hilger, Ltd.)

Diary of Societies.

FRIDAY, MARCH 6.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—E. D. D Davis and others: Discussion on Effects on Hearing after Fractured Base of the Skull: Lessons Resulting Therefrom.

ROYAL SANITARY INSTITUTE (at Guildhall, Swansea), at 3.—H. R. Tighe and others: Discussion on The Rheumatic Child.—Dr. J. M. Morris, E. Morgan, and others: Discussion on Housing.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. G. M. B. Dobson: A Photoelectric Spectrophotometer for Measuring the Amount of Atmospheric Ozone.—G. F. Tagg: Practical Investigations of the Earth Resistivity Method of Geophysical Surveying.—W. E. Pretty: Displacement of Certain Lines in the Spectrum of Ionised Oxygen (O II, O III), Neon (Ne II), and Argon (A II).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of the Nerve Supply of the Alimentary Tract and the Nature of Auerbach's Plexus.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (in Grosvenor Restaurant, Glasgow), at 6.45.—Annual Business Meeting.

SOCIETY OF DYERS AND COLOURISTS (jointly with Society of Chemical Industry) (at Engineers' Club, Manchester), at 7.—S. M. Neale: The Action of Caustic Soda on Cellulose.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—J. Urmston: The Electrical High-Pressure Testing of Cables and the Localisation of Faults.

JUNIOR INSTITUTION OF ENGINEERS (at Science Museum), at 7.—The Historic Locomotives at the Museum.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—A. M. Hug: The Netherlands East India State Railways and Electrification (Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—Dr. C. A. Matley: The Deserts of California (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. G. M. B. Dobson: Ozone in the Upper Atmosphere and its Relation to Meteorology.

SATURDAY, MARCH 7.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section) (at Bristol University), at 2.—Dr. M. Nierenstein, A. L. Taylor, Prof. R. J. Brocklehurst, A. L. Flemming, S. V. Stock, Dr. H. W. Featherstone, Dr. I. W. Magill: Symposium on the Barbiturates in Anæsthesia.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Lord Rutherford: Recent Researches on the Alpha Rays (1).

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 4.—H. G. Scott: The Blast Furnace, its Limitations and its Relation to the Cupola.

INSTITUTE OF BRITISH FOUNDRYMEN (Scottish Branch) (at Royal Technical College, Glasgow), at 4.—M. Russell: Pattern-making and its Relation to Design and Foundry Practice.

INSTITUTE OF BRITISH FOUNDRYMEN (West Riding Branch) (at Technical College, Bradford), at 6.30.—H. W. Swift: Commercial Tests for Cast Iron.

MONDAY, MARCH 9.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4.30.—Dr. E. D. Adrian: Electric Charges in Nervous Tissues.—*Papers to be communicated by title only*:—W. N. Bailey: Some Series and Integrals Involving Associated Legendre Functions.—J. A. Todd: The Groups of Symmetries of the Regular Polytopes.—H. S. M. Coxeter: The Densities of the Regular Polytopes.—L. Roth: Some Properties of Line Congruences.—W. H. Ingram: Note on the Operability of Synchronous Motor at the End of a Transmission Line.—R. H. Fowler: A Note on Ferromagnetism.—F. W. G. White: A Theoretical Discussion of the Electrical Properties of the Soil.—Dr. T. M. Harris: Rhætic Floras.—Prof. L. Hogben: Some Biological Aspects of the Population Problem.—Dr. V. B. Wigglesworth: The Respiration of Insects.

ROYAL SOCIETY OF MEDICINE (United Services Section), at 5.—Squadron-Leader H. L. Burton and others: Discussion on Minor Head Injuries.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. E. Shattock: Demonstration of Specimens illustrating Diseases of the Colon and Rectum.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—J. E. Arrowsmith: Pressings for Automobiles.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—J. W. Rissik and H. Rissik: Heavy-Duty Rectifiers and their Application to Traction Substations.

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

ROYAL SOCIETY OF ARTS, at 8.—A. G. D. West: The Recording and Reproducing of Sound (Cantor Lectures) (1).

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Major R. W. G. Hingston: Proposals for British National Parks in Africa.

CHARTERED SURVEYORS' INSTITUTION, at 8.—G. Lovegrove: The Amendment of the London Building Acts.

EUGENICS SOCIETY (at 20 Grosvenor Gardens, S.W.1), at 8.15.—Study Circle.

TUESDAY, MARCH 10.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. M. Critchley: The Neurology of Old Age (Goulstonian Lectures) (1).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. D. Darlington: The Cytological Theory of Heredity and Variation (1).

INSTITUTION OF CIVIL ENGINEERS, at 6.

INSTITUTE OF MARINE ENGINEERS, at 6.—G. S. Baker: The Efficiency and Steering Effect of Inward and Outward Turning Screws.

INSTITUTE OF METALS (Swansea Section) (at Y.M.C.A., Swansea), at 6.15.—Prof. F. C. Thompson: Some Researches on the Wire-Drawing Process.

EUGENICS SOCIETY (at 20 Grosvenor Gardens, S.W.1), at 6.30 and 8.30.—Study Circle.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.45.—E. C. F. King: Rust-proofing of Iron and Steel.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—P. J. Ryle: Two Transmission Line Problems: Suspension Insulators for Industrial Areas in Great Britain; Conductor Vibration.

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

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7.—H. R. Hiscott: Malleable Fittings.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.—H. L. Egerton: Domestic Hot Water Supply.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—E. T. Norris and F. W. Taylor: High-Voltage Testing Equipments.—B. L. Goodlet, F. S. Edwards, and F. R. Perry: Dielectric Phenomena at High Voltages.

INSTITUTE OF METALS (North-East Coast Section) (Annual General Meeting) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—R. D. Burn: The Longmaid-Henderson Process for the Extraction of Copper.

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—C. D. Soar: British Acarina.

WEDNESDAY, MARCH 11.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—Lt.-Col. J. T. C. Moore-Brabazon: Motor Racing and its Influence on Technical Design.

INSTITUTE OF FUEL (at Chemical Society), at 6.—J. Roberts: Formation of Coke.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—R. Harding: The Automatic Stabilisation of Ships.

ROYAL SOCIETY OF ARTS, at 8.—A. J. Davis: Architectural Decoration.

EUGENICS SOCIETY (at Linnean Society), at 8.30.

TELEVISION SOCIETY (at University College).

THURSDAY, MARCH 12.

ROYAL SOCIETY, at 4.30.—E. W. Fish: On the Reaction of the Dental Pulp to Peripheral Injury of the Dentine.—E. B. R. Prideaux: The Combination Curves, Hydrogen Ion Regulating Power and Dissociation Constants of Gelatin.—R. Snow: Experiments on Growth and Inhibition.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—W. G. Bickley: Some Integrals Involving the Jacobian Zeta Function, and the Sums of Certain q Series.—H. S. M. Coxeter: Groups whose Fundamental Regions are Simplexes.—C. Fox: An Integral Transform and Some Applications.—S. Goldstein: A Note on Certain Approximate Solutions of Linear Differential Equations of the Second Order.—F. H. Murray: Asymptotic Dipole Expansions for Small Horizontal Angles.—R. Wilson: Eliminants of Characteristic Equations.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. M. Critchley: The Neurology of Old Age (Goulstonian Lectures) (2).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. B. S. Haldane: Respiration (4).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—J. W. Rissik and H. Rissik: Heavy-Duty Rectifiers and their Application to Traction Substations.

ROYAL AERONAUTICAL SOCIETY (jointly with Institute of Transport) (at Royal Society of Arts), at 6.30.—Capt. C. Florman: Night Air Mails.

INSTITUTE OF MARINE ENGINEERS (Junior Section), at 7.—H. R. Tyrrell: Experiences of a Junior Engineer on his First Voyage.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—J. Kwantes: Chemistry in Beet Sugar Manufacture.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.

INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers), at 7.45.—Dr. A. B. Everest: Cast Iron To-day.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—O. G. Morgan and Dr. C. P. Symonds: Unilateral Ophthalmoplegia with Absent Tendon Jerks.—Dr. R. Brain: Grasp Reflex in the Foot.—Cinematographic Demonstrations:—Dr. S. Barnes: A Case of Unusual Dissociation of Voluntary Eye Movement.—Dr. H. Cohen: Technique and Results of Encephalography and Ventriculography.

FRIDAY, MARCH 13.

BIOCHEMICAL SOCIETY (Annual General Meeting) (at University College), at 3.—Prof. C. Lovatt Evans, Chiao Tsai, and F. G. Young: A Note on the Estimation of Liver Glycogen.—R. A. McCance and H. L. Shipp: The Colorimetric Determination of Sodium.—E. Stedman and Ellen Stedman: Studies on the Relationship between Chemical Constitution and Physiological Action. Part III. The Inhibitory Action of Certain Synthetic Urethanes on the Activity of Liver Esterase.—B. C. J. Knight: An Electrolytic Method for Poising the Oxidation-reduction Potential of Culture Media.—G. F. Marrian: Observations on the Physiological Potency of Crystalline Tri-hydroxy Œstrin.—Prof. T. P. Hilditch and J. J. Sleightholme: The Glyceride Structure of Butter Fats.—H. R. Ing and R. N. Kekwick: A Note on Acyl Derivatives of Creatine and Creatinine.—I. S. MacLean and M. S. B. Pearce: Oxidations of Oleic Acid *in vitro* and their Bearing on the Biological Oxidation of Oleic Acid.—C. Rimington and A. M. Stewart: A Pigment from the Suint (Sweat Fraction) of Raw Sheep's Wool.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—Dr. H. H. Mann: The Tea Industry of India in its Scientific Aspects.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Sir A. S. Eddington: A Theorem concerning Incomplete Polytropes.—J. Young: Occultations of Stars by the Moon observed at Birmingham University during 1930.—T. Matukuma: Relativity Effect in the Problem of Latitude Variation.—J. Dufay: Effect of Atmospheric Absorption in Stellar Spectrophotometry.—J. H. Hindle: A New Test for Cassegrain and Gregorian Secondary Mirrors.—V. V. Narliker: The Significance of Bode's Law in Relation to Satellite Systems.—L. H. Thomas: The Slow Contraction and Expansion of a Fluid Sphere. II. Stability.—S. Chandrasekhar: The Dissociation Formula According to the Relativistic Statistics.—C. S. Beals: Wave Lengths of Oxygen and Nitrogen Lines in the Stellar Region.—Royal Observatory, Greenwich: Observations of Solar Flocculi, made with the Spectrohelioscope during 1930.—Dr. H. H. Plaskett: The Formation of the Magnesium b Lines in the Solar Atmosphere.—B. Strömgren: The Possible Solutions of the "Equations of Fit" on the Standard Model.—T. G. Cowling: Note on the Fitting of Polytrope Models in the Theory of Stellar Structure.—S. Chandrasekhar: The Highly Collapsed Configurations of a Stellar Mass.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens illustrating the Anatomy, Physiology, and Pathology of the Œsophagus.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle upon-Tyne), at 6.—S. F. Dorey: Some Factors Influencing the Sizes of Crankshafts for Double-Acting Diesel Engines.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—C. J. F. Tweed: Aspects of the Transmission and Reception of Still Pictures.

INSTITUTE OF FUEL (North-Western Section) (at Engineers' Club, Manchester), at 7.—Dr. G. E. K. Blythe: The Industrial Application of Pulverised Fuel.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Dr. F. A. Mason: Recent Lines of Advance in Lake and Pigment Chemistry.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—L. Clegg: Phenol Formaldehyde Moulding Compositions, Manufacture and Use.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society), at 8.—W. J. Rees: The Manufacture of Lime.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—J. C. Squire: Parody.

SATURDAY, MARCH 14.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Lord Rutherford: Recent Researches on the Alpha-Rays (2).

ANNUAL MEETING.

MARCH 11 AND 12

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M., etc.

Papers to be submitted:

S. L. Archbutt and W. E. Prytherch: Investigation of the Effect of Impurities on Copper. Part VII. The Effect of Antimony. Part VIII. The Combined Effect of Antimony and Arsenic.

L. J. Brice: Some Properties of Silicon-Aluminium Bronzes.

Capt. W. F. Collins: The Corrosion of Early Chinese Bronzes.

Dr. P. J. Durrant: The Constitution of the Cadmium-Rich Alloys of the System Cadmium-Silver.

Dr. C. F. Elam: An Investigation of the Microstructures of Fourteen Silver Greek Coins (500-300 B.C.) and some Forgeries.

O. W. Ellis: The Rolling of Alloys of Copper and Phosphorus containing up to 5 per cent of Phosphorus.

Dr. H. J. Gough and H. L. Cox: The Mode of Deformation of a Single Crystal of Silver.

J. D. Grogan and D. Clayton: Dimensional Stability of Heat-treated Aluminium Alloys.

Prof. D. Hanson: The Flow of Aluminium at Elevated Temperatures.

T. P. Hoar and R. K. Rowntree: Note on the Silver-Rich Aluminium-Silver Alloys above 600° C.

Dr. C. H. M. Jenkins: Some Properties of Metallic Cadmium.

Dr. K. L. Meissner: The Effect of Artificial Ageing upon the Resistance of Super-Duralumin to Corrosion by Sea-Water.

C. E. Pearson and Dr. J. A. Smythe: The Influence of Pressure and Temperature on the Extrusion of Metals.

Dr. D. Stockdale: The Solid Solutions of the Copper-Silver System.

PUBLIC LECTURES.

FRIDAY, MARCH 6.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 5.30.—Prof. H. Wieland: Studies on Biological Oxidation (Pedler Lecture).

SATURDAY, MARCH 7.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Mediæval Maps and Travellers' Tales.

MONDAY, MARCH 9.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 2.—T. D. Young: Meat Inspection.—At 5.—J. C. Dawes: Public Abattoirs: Lay-out, General Arrangement, etc.

LONDON SCHOOL OF ECONOMICS, at 5.—Rev. Edwin W. Smith: The Application of Social Anthropology to Practical Affairs. (Succeeding Lectures on Mar. 10 and 11.)

TUESDAY, MARCH 10.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.15.—Dr. E. W. Hurst: Desseminated Encephalomyelitis following the Exanthemata (Vaccination, etc.).

KING'S COLLEGE, LONDON, at 5.30.—Prof. G. Dawes Hicks: Sense Perception and Physical Things.

WEDNESDAY, MARCH 11.

BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 5.15.—Dame Louise McIlroy: Maternal Mortality (Chadwick Lecture).

ROYAL ANTHROPOLOGICAL INSTITUTE (at Portland Hall, Great Portland Street, W.1), at 5.30.—E. Torday: The Things that matter to the West African.

KING'S COLLEGE, LONDON, at 5.30.—Prof. E. G. R. Taylor: The Great Age of Discovery: The Northern Passages.

THURSDAY, MARCH 12.

UNIVERSITY COLLEGE, at 5.30.—Dr. A. M. Bassani: Pompei (in Italian).

TEXTILE INSTITUTE (London Section) (at Barrett Street Trade School, W.1), at 7.—Sir Francis Goodenough: Salesmanship.

FRIDAY, MARCH 13.

BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 8.—Prof. E. Mellanby: Diet and Health (Sir Charles Hastings Lecture).

SATURDAY, MARCH 14.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Augustan Age.

CONFERENCE.

FRIDAY, MARCH 6.

INSTITUTION OF CHEMICAL ENGINEERS (Annual Corporate Meeting).

Friday, Mar. 6 (at Hotel Victoria), at 11 A.M.—Presentation of the Osborne Reynolds Medal, the Moulton Medal, and the Junior Moulton Medal.

At 11.45 A.M.—The President and others: Discussion on The Education and Training of the Chemical Engineer.

At 2.15.—Dr. D. M. Newitt: The Flow of Gases at High Pressures through Metal Pipes.

CONVERSAZIONE AND EXHIBITION.

SATURDAY, MARCH 7.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.