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State Intervention and Agriculture

STATE intervention in a particular industry is one of those subjects which most probably would have been rejected by the Council of the British Association had it not happily decided to include within its ambit the interactions of science and the life of the people. It is true that this development tends to bring the sciences into closer touch with economics and politics, but one day economics may be established as a fully inductive science, and knowledge obtained by impartial scientific inquiry will be the basis of political action.

State intervention is increasing everywhere, and for reasons which are not far to seek. Industrial and social relations generally have multiplied so greatly and become so exceedingly complex that only a supreme authority can co-ordinate them. An industrial system based upon the law of the jungle is no longer regarded either as ethical or efficient. Morality has not kept pace with material progress, and the basest uses are being made of some of the fruits of science and invention. The view that the functions of the State should be restricted to protecting its citizens against external aggression and maintaining justice between them is still valid if we accept a wider connotation of the word 'justice'. Probably most of us now consider it right that the State should control the conditions of industrial competition ; that it should abolish privilege as a right to which no corresponding function is attached ; that it should so far as possible give equal opportunity to all ; and many think that it should secure to every worthy citizen a sufficiency of the basic necessaries of life—wholesome food, clothing, shelter and facilities for re-creating mind and body.

Opposed to this growing recognition of the need for extended State action is the inborn longing for individual freedom, and one of the major problems of civilization is how to reconcile the freedom required for individual development and self-expression with the restraints which the State must impose to save itself from anarchy and disruption, and to give every citizen a fair deal. No one with any faith in the future believes that these two ideals are fundamentally incompatible. Science, art and industry provide the knowledge and the means for attaining a full, free and happy life ; and yet it eludes us—probably because the necessary emotional stimulus is lacking. The older religions no longer seem able to impart this stimulus. Can devotion to high ideals of conduct and attainment take their place ? Man began by being a slave to his environment ; he acquired the elements of freedom when he learned to adapt himself to it, and to co-operate with his fellows ; his freedom grew as science taught him how, in a measure, to control his environment ; it will grow still more as he learns to control himself and develop a social conscience. Laissez-faire is on its death-bed ; State intervention, regulative, controlling or dominating is taking its place. To many it is a necessary evil, but it will persist so long as individuals and communities play a lone or selfish hand. The ecclesiastics who demand a 'change of heart' are right : "The solid ground of nature"—like patriotism—is not enough.

The incongruity of State regulation or control and personal freedom, in relation to agriculture, was well brought out by Mr. J. M. Caie in his presidential address to Section M (Agriculture) of the British Association. As assistant secretary to the Department of Agriculture for Scotland, his pronouncements were necessarily guarded, but it was clear that, although he recognizes the

inevitability of State intervention in existing circumstances, he deplores its extension, believing with the fourteenth century poet, Barbour, that "Freedom is ane noble thing". Liberation, if only partial, waits on the return of economic prosperity, and the road thereto lies in securing for farmers a fair share of the home market, and in inducing them to eat of the fruits of education and research. The personal factor, he is convinced, is still extremely important, and the progressive farmer is usually the last to seek aid from the State.

The trouble here is that it has always been found difficult to induce farmers, as a class, to adopt the innovations indicated by scientific research (Australian farmers took to the use of superphosphate twenty-five years after its value had been demonstrated). Great Britain possesses some research institutions of the highest class and a goodly number of well-equipped agricultural colleges and farm institutes, yet farmers fail to take full advantage of them. We have some of the best farmers in the world, but, according to high authorities, our general standard of farming is relatively low. In recent years farmers have had to contend with very low prices for their produce, and many of them have not been able to afford the purchase of new equipment; but prices are now better, and the time now appears opportune for making an organized effort to 'put over' to the rank and file of farmers the practical results of recent research. Farm-equipment, seed-dressing, grassland management, fertilizers and composts, ensilage, grass-drying, and farm accountancy are all subjects in which progress has been made and to which the farmers' attention should be directed. This question is of very wide import and might well be discussed at a future meeting of Section M.

No one will deny that the Ministry of Agriculture has been alive to the hardships and responsive to the importunities of farmers; with its aid the production of sugar-beet has increased from 102,000 tons in 1923 to 3½ million tons in 1936–7, and that of wheat by 44 per cent since 1932. It is now extending its protection to growers of barley and oats, and—what is more important—is coming to grips with the fundamental problems of maintaining the fertility of the soil, by paying half the delivered cost of lime and one quarter that of basic slag; and improving the health of livestock, by instituting a vastly extended veterinary service. Less directly, the Government has assisted agriculture by fathering the establishment of marketing boards for milk, potatoes, hops and bacon, and of a commission for fat cattle. These boards have, in the main, succeeded in enabling producers to get better prices, in mitigating the effects of violent price fluctuations, and in controlling the quality of certain marketed produce. On the other hand, some of the schemes are exceedingly complicated and require an army of officials and employees to work them, whilst the criticism is often heard that consumers' interests have not been adequately safeguarded; for example, the price of milk for liquid consumption is held to be excessive. In Germany the cost of distributing milk is stated to be only about one half of what it is in Great Britain, so that by adopting a system of State control from cow to consumer similar to the German, we might save £10,000,000 a year on this item alone. Nothing appears to have been done to reduce the lamentable 'spread' between producers' and consumers' prices, and the conviction is growing that the Government must be driven to tackle the general problem of distribution and consumption, and to institute a census forthwith.

So far governmental efforts have appeared to concentrate on symptoms and palliatives rather than on radical cures, and legislation has been too piecemeal. Desperate diseases require desperate remedies, and that no doubt is one reason why Sir Daniel Hall, in the inter-sectional discussion at Nottingham on "Planning the Land of Britain" advocated the nationalization of the land, and why Prof. R. G. Stapledon has come reluctantly to the same conclusion in regard to the improvement of our upland pastures. Another urgent problem the solution of which is defying the efforts of the Government, is how to reconcile the demands of home farmers with those of producers in the self-governing Dominions; and no solution to the problem of increasing our supplies of home-grown food to make us secure in time of emergency is yet forthcoming.

These and other problems confronting agriculture and the community are of such magnitude and complexity that no one expects them to be resolved overnight. They transcend the ability of individuals and are therefore rightly passed on to the State. Many of them are of international moment, and most of them bear direct relation to the riddle of how to raise the purchasing power of the masses so as to give them a higher standard of life. The important thing is to rule out drift. Social change, like all change, is ineluctable, but it can be controlled and directed towards social betterment.

Ionospheric Disturbances, Fadeouts and Bright Hydrogen Solar Eruptions

By

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A. J. Higgs and Dr. S. E. Williams, Commonwealth Solar Observatory, Canberra

FOR some months we have been recording daily the equivalent heights and reflection coefficients of the F_2 region of the ionosphere, for radio frequencies near to the critical penetration frequency of the region. Under these conditions, the recorded quantities are exceptionally sensitive to small changes in the electron density of the F_2 region.

Examination of our results reveals the frequent occurrence of a type of disturbance which has the following definite features :

(*a*) the equivalent height rises sharply in a period of a few minutes ;

(*b*) the intensities of the reflected echoes decrease at the same time as (*a*) ;

(*c*) after some minutes the heights decrease and the intensities return to normal ;

(*d*) although the disturbance may now be said to have ended, the F_2 region is left higher than before, although the F_2 electron density has returned to its original value, as evidenced by the separation of the ordinary and extraordinary magneto-ionic components, and other tests.

The record of a typical disturbance, which occurred on May 15, 1937, between 0920 and 1005 hours Eastern Australian Standard Time, is reproduced in Fig. 1. For reasons of lack of space, only the most marked period of the disturbance, between 0932 and 0955 is shown in the figure. The heights and intensities are recorded for periods of $2\frac{1}{2}$ minutes each successively, on frequencies of 9·75 and 10·7 mc./sec. The ground wave appears along the lower edge of the diagram, its intensity being measured by the breadth of the trace downwards and to the left, according to a technique as yet unpublished. It is seen that the ground wave is very weak for the lower frequency, while at 0945 and 0950 the ground wave on the higher frequency appears specially strong. The latter circumstance is due to the observer increasing the sensitivity of the receiver in an unavailing attempt to record echoes at this frequency. At 0932 are seen strong echoes from the F_2 region at equivalent heights of 400 and 295 km. These are respectively the ordinary and extraordinary components into which the wave is split by magnetic double refraction in this region. The doubly reflected echoes are seen above. The intensities of these echoes are indicated in the manner described above for the ground wave.

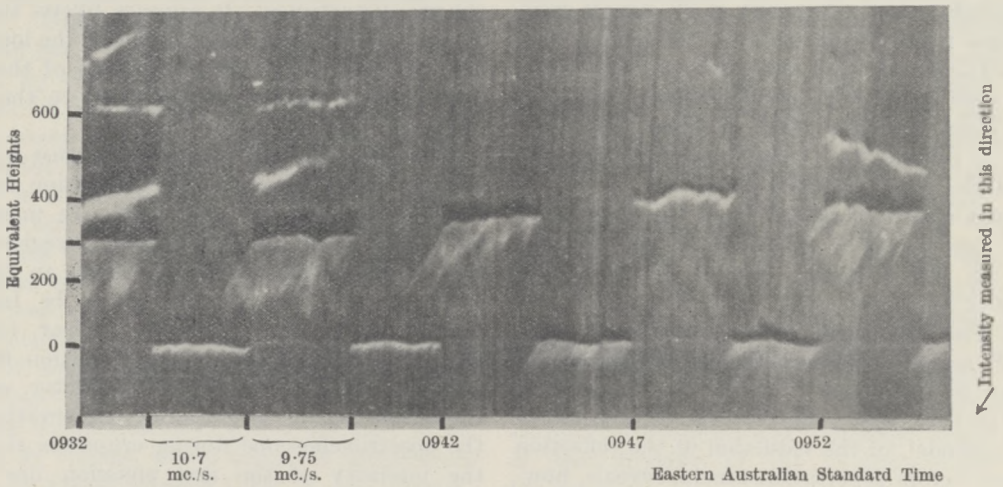

Fig. 1.

EFFECT OF BRIGHT HYDROGEN ERUPTION ON EQUIVALENT HEIGHTS AND ECHO INTENSITIES FROM F_2 REGION OF IONOSPHERE. VISUAL OBSERVATIONS WITH SPECTROHELIOSCOPE IN $H\alpha$ SHOWED BRIGHT SPOT BETWEEN 0922 AND 0940 HOURS E.A.S.T.

It is seen that the equivalent heights rise steadily until 0948, when the ordinary wave has penetrated the region while the extraordinary echo is of much reduced intensity. At 0955 the intensity of the extraordinary component is almost normal, but the equivalent height is now 365 km., which is much greater than obtained before the disturbance commenced. The intensity of the ordinary component returned to its normal value at 0957, and the heights returned to normal at 1005. On three occasions, namely, at 1250–1330 April 24, 1140–1220 May 25, and 1200–1300 June 11, the disturbances, while exhibiting all the characteristic features described above, were so pronounced that echoes practically disappeared. On each of these occasions, reference to the La Perouse receiving station of Amalgamated Wireless Australasia, Ltd., revealed that a fade-out of all signals from short-wave transmitting stations throughout Australia had occurred, while only a few overseas transmitters were heard, with greatly reduced intensity.

It is clear, therefore, that so-called 'fade-outs' are due to particularly strong ionospheric disturbances of the type described above.

The non-return of echoes from the ionosphere can be due to (α) a reduction of the electron density in the reflecting region, or to (β) an increase of ionization in an absorbing region. It is clear from the above that (α) does not occur in the F_2 region. For example, the disappearance of echoes on the higher frequency in Fig. 1 must be due to this cause. Calculation by well-established methods[1], of the reduction of the reflection coefficient before penetration occurs, reveals, however, that the observed reduction of ionization in F_2 is not by itself sufficient to account for the observed reduction of echo intensity.

We have obtained further information on this point from records showing equivalent height-frequency curves, which have been obtained automatically at half-hourly intervals with equipment formerly described[2]. On some occasions, when a disturbance has been observed in progress, the operation of this apparatus has been quickened, so that it measured the ionization densities of the various reflecting regions E_1, E_2, F_1, F_2 at five-minute intervals. From the auxiliary data obtained in this way it has been found that almost simultaneously with the *reduction* of ionization in the F_2 region, there occurs an *increase* in the ionization of the absorbing D region below 100 km. This is clearly shown by the weakening, and occasional complete disappearance of the E (and F) echoes obtained on low frequencies, although these echoes may be received almost unimpaired on higher frequencies.

It has been shown by Dellinger[3] and others that fade-outs sometimes occur almost simultaneously with bright hydrogen eruptions on the solar
although only a small fraction of observed erup
appear to be effective in this connexion. We
strong evidence that *every* solar eruption obse
at the Commonwealth Solar Observatory oc
almost simultaneously with an ionospheric dist
ance of the type described above, although or
fraction of these disturbances are large enoug
cause a complete 'fade-out'. Thus of forty
eruptions observed during March–June 1937, fe
one were observed or estimated to begin w
ten minutes of the beginning of an ionosp
disturbance, while only three eruptions prod
no observable disturbance. It is further t
observed that, in the latter three cases,
eruptions followed closely after the occurrenc
an earlier eruption which did produce an i
spheric disturbance. It appears likely, there
that in each of these three instances the ionosp
had not recovered from the effects of the ea
disturbance sufficiently to respond to the se
eruption.

It is clear that all these effects must be du
sudden bursts of ultra-violet radiation from
eruptive area on the solar disk. In many c
the results show that the normal D region io
tion is more than doubled during an erup
although the eruptive area may be less
1/2,000 of the solar disk. It is clear, there
that the effective ultra-violet radiation from
eruptive area increases by a factor of s
thousands during an eruption. Observations
the spectrohelioscope during eruptions show
the intensity of the first emission line of
Balmer series of hydrogen (H_α) increases b
factor of about ten in the eruptive area,
similar observations in the ultra-violet are
course, unobtainable owing to atmospheric abs
tion.

We find very strong evidence that the n
effects produced in the ionosphere during
eruption are due to solar emission of the Ly
resonance line L_α (1215·6 A.) of hydrogen, w
must be emitted in great intensity from
eruptive area.

No hydrogen radiation other than L_α is cap
of penetrating the earth's atmosphere to the d
of the D region, but Hopfield[4] has shown
air has just the necessary transparency ov
limited spectral region around the wave-length o
Moreover, no solar radiation capable of dir
ionizing oxygen or nitrogen is capable of penetra
to the D region. Chapman and Price[5] have poi
out, however, that the oxygen atom in th
state resonates to L_α radiation (if a few angst
wide) and is raised to the ^1P state. If a coll
occurs in this state, it can lose an electron
0·75 electron volts, thus reverting to the no

state of ionized atomic oxygen. For this to happen it is obviously necessary that the life-time of the atom in the ^1P state must be comparable with, or greater than, the mean time interval between collisions. This condition is satisfied in the D region, where the electron collision frequency is approximately 5×10^7 per second. It is not likely to be satisfied in the E or higher regions, so that we should not expect increased ionization in these regions due to L_α radiation. The abundance of oxygen atoms in these regions is beyond doubt.

The *decrease* of ionization density in the F_2 region during an eruption is also explained by the great increase in L_α radiation. The radio data show conclusively that the region, and the atmosphere below to some yet undetermined level, is considerably heated and expanded during an eruption. This is evidenced by the pronounced rise in the real height of the F_2 region during an eruption, by the reduction of the density of the ionization in this region, by the comparatively rapid recovery of the F_2 ionization due to rapid cooling of the very hot F_2 region, and by the slower recovery of F_2 height due to the slower cooling of the less hot regions below. The work of G. H. Godfrey and W. L. Price, which is in course of publication, shows that in the absence of water vapour these regions would reach an equilibrium temperature of 3,200° K. due to the absorption by oxygen of solar ultra-violet radiation of wave-lengths about 1450 A. It is the presence of water vapour, in concentration of about one part in ten thousand by volume, which keeps the temperature down to the values between 1,000° K. and 2,000 K. which are found experimentally by Martyn and Pulley[6] in the F_2 region.

It has been recently shown by Rathenau[7] that water vapour shows strong absorption bands at the wave-length of L_α, such absorption leading to dissociation of the H_2O molecule into H and OH*. It is clear, therefore, that the strong L_α solar radiation during an eruption must dissociate much of the water vapour present in the upper atmosphere, so leading to higher equilibrium temperatures in the ionosphere. The application of Godfrey and Price's calculations shows that these temperatures are attained in a few minutes, and leads to a detailed explanation of the observed phenomena in the F_2 region during an eruption.

The origin of the numerous ionized levels of the ionosphere is still unknown, progress having been impeded by lack of knowledge of the solar radiation in the ultra-violet. The assumption of black body radiation in this region only increases the difficulties of interpretation by providing an infinite variety of ionizing radiation. It is a fortunate circumstance that the increased radiation during an eruption is confined to relatively few wave-lengths, with L_α almost certainly predominant. We believe that the study of the behaviour of the ionosphere while the sun is providing increased energy at these relatively few wave-lengths must greatly increase our knowledge of the normal structure of the ionosphere, and of the normal solar ultra-violet radiation. With this object in view we are now studying the effects of solar eruptions on the E_1, E_2, F_1 and G regions, in all of which smaller but appreciable changes occur.

This work is published by permission of the Radio Research Board of the Commonwealth Council for Scientific and Industrial Research, and of the director of the Commonwealth Solar Observatory.

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Geographical and Cultural Regions

A JOINT discussion between members of Section E (Geography) and Section H (Anthropology) was held at the British Association meeting at Nottingham on the subject of geographical and cultural regions. The primary object was to clarify the concepts of regional divisions of the earth's surface from various points of view.

A large measure of agreement on the fundamental principles of regional division from the point of view of the geographer was revealed. Its essential object is to distinguish different environments, and there was no divergence from the view that the most permanent contrasts, and those most important in relation to human life, are determined by natural factors (position, physical features, structure, climate, soils and vegetation). The total complex of conditions characterizing the personality of any such 'environment region' is, however, in practically every case profoundly modified by man, who must himself be included as one of the creative factors. Entirely 'natural' regions are now comparatively rare; for example, it was pointed out that very little of the tropical forest of Africa is in a true sense primitive. Subject to this qualification, the concept of major natural regions, as worked out at the beginning of the century by

Prof. Herbertson of Oxford, is of great and lasting value.

It is important, however, to distinguish two aspects of regional division. Regional schemes such as that of Herbertson are *generic* in character. A type is defined, based on fundamental criteria of climate and other factors, and its distribution over the earth's surface examined. All the representatives of the type broadly resemble each other in these particular respects and their 'intrinsic conditions' are comparable. But generic classifications of this kind cannot take into account the factor of geographical orientation, which in its influence on the evolution of human societies and the moulding of the *genre de vie* is often quite as important as the intrinsic conditions. The Sahara and the Atacama in Herbertson's scheme both belong to the category of hot deserts ; but the geographical position of the Sahara between the Mediterranean lands and tropical Africa has profoundly influenced the evolution of its trading societies and differentiated its human life from that of the Atacama. So, too, while there is a 'Mediterranean' type of climate, vegetation and production, which is found in five or six widely separated parts of the world, the Mediterranean region of the Old World in the sum total of its conditions and in its geographical setting has no real parallel elsewhere.

Thus, apart from generic classifications, the attempt is made by geographers to distinguish what may be termed *specific* regions with a particular location and a combination of conditions found nowhere else. There are different 'orders' of such regions, ranging from the *pays* of France (Beauce, Brie, etc.) to such large concepts as 'Western Europe'. When over wide areas there is found a particular set of intrinsic conditions in combination with a very definite geographical orientation, we have distinctive theatres of human life which are characterized by a series of closely linked physical and human phenomena. Examples of such large 'human provinces', if the phrase may be allowed, are North China (north of the great climatic, vegetational and economic divide of the Tsin-ling shan), the Lower Yang-tze Basin (below the Gorges) and South-East China (south and east of the Nan-ling and its continuations). In such attempts to define large specific regions it is often necessary to recognize transitional zones and to admit that human agency, as in the case of the North German Lowlands in recent times, may change considerably not only the intrinsic conditions but also the value of the geographical orientation.

The discussion at Nottingham on the concept of cultural regions and their relationship to geographical divisions of the earth's surface was mainly negative. On the ground that race, religion and language are all unsatisfactory and dangerous as criteria, several of the anthropologists present were unwilling to admit the validity of the concept of cultural regions, except in respect of limited areas defined in terms of material culture-traits such as those which Mr. Clark Wissler has determined for aboriginal North America. Owing to its isolation and comparative immunity from new waves of cultural influence Pre-Columbian North America presented a more favourable field than Asia or Africa for the establishment of relatively stable culture-complexes broadly corresponding to natural 'food-regions'. But even these passed through many phases and interacted in complex ways before the final disintegration caused by the advent of the white man.

Admitting the force of these contentions, the question remains whether it is not still legitimate and indeed important to distinguish regional types of civilization. A notable passage in Mr. R. H. Hudson's scholarly work on "Europe and China" is worth recalling :

"There is a hierarchy and ranking of nationalities in accordance with degrees of community or separateness in cultural inheritance. There is the supreme nationality which is mankind. Within this greatest whole are the few great unities formed by continuous dominant traditions of original civilisation, and within these again are the many lesser groups, determined mainly by present spoken language, which are the only 'nations' known in ordinary speech.

"Europe and China are nations of the first division of mankind : they are great continuities of historical development which may embrace many distinct languages and political units. . . The real unity in each case has been one of culture tradition. Europeans are all peoples and states deriving their dominant cultural form directly or indirectly from Hellenism, Chinese those deriving it from the 'Chinese' empire of the Hwang-ho basin in the first millennium B.C."

Is it denied that, in spite of the complexities and new ideologies of the modern world, there are still certain "great unities formed by continuous dominant traditions of original civilisation" ? Is it no longer valid to make the distinction between the European and the Chinese type of civilization ? Has not the real unity of China been in a broad sense 'cultural' ? Or, if 'culture' must be used in a more restricted sense, what other term should be employed to express a unity that has been immensely powerful and yet has been neither national nor political ? These questions may be asked with full consciousness of the intricacy of modern civilization and the possibility of rapid change in cultural affinities such as seems to be illustrated by the Turkish national State since the Great War.

P. M. ROXBY.

Chemistry of Building Materials

AT the meeting on September 7 of Section B (Chemistry) of the British Association, there was a symposium on "The Chemistry of Building Materials". After an introduction by Dr. R. E. Stradling (director of the Building Research Station), papers were presented by Dr. F. M. Lea (Building Research Station) on "Some Problems in the Study of Hydraulic Cements", Dr. J. S. Dunn (Imperial Chemical Industries, Ltd.) on "Calcium Sulphate Plasters; Setting, Retarders and Accelerators", Mr. F. H. Clews, Mr. H. H. Macey and Dr. G. R. Rigby (British Refractories Research Association) on "Some Important Properties of Clay", and Dr. D. G. R. Bonnell (Building Research Station) on "Some Problems connected with Porous Building Materials".

Building presents an excellent example of a traditional industry in the stage of transition to an applied science. It is an industry founded originally on craft and based on rules of experience which have become enshrined in traditional methods. To the older building materials such as timber, stone, burnt clay and lime, there has been added in modern times a host of new products, whilst the demand for speed and economy in building has resulted in numerous changes in methods. These changes have often been in the nature of extensions and modifications of traditional processes, but they have been made without that full knowledge of the reasons for the success of the traditional methods which is necessary if development is to have a sure basis and to be other than the slow and costly traditional method of trial and error. Modern conditions have necessitated, therefore, not only the examination of the newer materials and processes, but also the study of the traditional materials and of the reasons for the success of the traditional methods.

This is well exemplified in the craft of the plasterer. The production of lime was formerly a local industry, and the craft by long experience had become adapted to the properties of the local materials. The modern development of large-scale production has led to the wide distribution of materials which, though outwardly similar, differ in properties from those to which the craftsman was accustomed. Calcium sulphate plasters have been added as an additional plastering medium, but materials of this class, differing widely in properties, and in the methods necessary for their successful handling, are distributed under trade names giving no clue as to the type to which they belong. The substitution of Portland cement mortar for lime mortar in rendering and stucco, again without adequate appreciation of the very different properties given to the finished product, has been a very common cause of trouble.

As was pointed out by Dr. Stradling, the craftsman in lime and plaster controls a chemical reaction of which he knows nothing. While working with materials in which he had long experience, the craftsman could produce excellent work; with materials of different physical properties and rates of reaction, however good these materials might be, there entered factors to which he was unaccustomed, and of which he had no warning, and his craft suffered in consequence.

The problems in building to-day are, however, not only due to insufficient knowledge of the fundamental properties of its materials of construction, but also, and in considerable degree, to insufficient dissemination of the existing knowledge among architects, builders, engineers and craftsmen. Whilst research on materials is now proceeding at a rapid rate in many countries, the need for further education in the building industry is only too clear.

The discussion at the meeting of Section B could inevitably only cover a small part of the field indicated by its title, but it sufficed to bring forward many interesting problems.

Apart from the metals and igneous rocks, all building materials are porous and capable of absorbing water to some extent. Changes in moisture content, not only on first drying, but also in subsequent use, produce accompanying changes in volume and in other physical properties such as strength and elasticity, while the movement of water, carrying soluble salts in solution, gives rise to surface efflorescence and to decay of masonry and brickwork. The change in volume is responsible for much of the cracking found in buildings. In practice it is relieved to some extent by the ability of materials to creep, or undergo plastic deformation under load. Though much work has been done on shrinkage and creep, there is still need for further study of moisture movements under conditions of restraint, such as normally occur in building. The general phenomenon of volume change in porous solids has as yet interested chemists relatively little though it offers a promising field for research. The work of Meehan and Bangham on the expansion of charcoal by sorption of gases and vapours is suggestive in this connexion.

Calcium sulphate plasters can be grouped generally into the hemihydrate and the anhydrite types, the latter being produced by the burning of gypsum

at relatively high temperatures or from the natural mineral. The system calcium sulphate - water is of the simplest binary type, but despite much work since Lavoisier's original contribution in 1765, the problem of the dehydration products of gypsum has never appeared fully solved. It has usually been considered that the partial dehydration of gypsum results in the formation of the hemihydrate, $CaSO_4.\frac{1}{2}H_2O$, but Dr. Dunn reported that the crystal form of this compound remains unaffected, with but minor changes in the lattice constants, with water contents ranging from 0 to 0·65 molecules of water. It is considered probable, therefore, that there is a zeolitic series with $3CaSO_4.2H_2O$ and $CaSO_4$ as end members. Plasters containing the so-called hemihydrate usually require to be retarded as otherwise their rate of set is too rapid for normal use in building. Two types of retarder can be distinguished, one reducing the rate of nucleus formation and the other acting similarly, but, in addition, modifying the habit of the gypsum crystals, giving a relatively slower rate of growth along the *c* axis. The rate of set of anhydrite plasters is very slow and, in practice, an addition of an accelerator is required. In general the hydration is accelerated by sulphates of the alkali and other metals, but the most effective catalysts are those combining an alkali metal sulphate with the sulphate of another metal such as zinc, the effect being more than additive and an optimum ratio existing for the two sulphates. The alkali metals accelerate the growth of gypsum crystals most at right angles to the *c* axis, while zinc sulphate is more specific for growth parallel to that axis. This observation takes the explanation of the action of a two-component catalyst one stage forward, but the problem of how each catalyst stimulates crystal growth still remains.

Though the most obvious property required in a cement is that of developing strength, in practice this presents few problems compared with those arising from volume change and physical and chemical decay. The heat of hydration of Portland cement, which may amount to a hundred calories per gram, is a source of considerable trouble in concrete structures of large mass. The internal temperature in concrete dams, for example, may rise as much as 50° C. above the original temperature of the materials, and the thermal contraction which takes place during subsequent cooling is the main cause of cracking in such structures. The production of cements with a reduced heat of hydration, and their utilization in recent work, such as Boulder Dam on the Colorado River, U.S.A., can be traced back to the much increased knowledge of the constitution of Portland cement which has resulted from phase equilibrium studies on many of the oxide systems involved.

The relative properties of vitreous and crystalline phases of the same gross composition is a matter of much interest in cement technology at the present time. During the burning of Portland cement, some 20–30 per cent of the mass passes into the liquid condition, but the extent to which this liquid crystallizes on cooling, or supercools to form a glass, probably varies considerably. There is evidence that unexplained differences in properties of cements of similar composition and fineness may have their origin in variations of this kind.

Clay is amongst the oldest of the raw materials of building and it has been successfully moulded, burnt and used for some thousands of years without any scientific knowledge of its chemical constitution or physical properties. A certain degree of control was, however, formerly exercised by Acts of Parliament. In 1477, in the reign of Edward IV, an Act required that the clay should be dug before November 1, turned over before February 1 and not used before March 1. Even so late as the reign of George III, there came an added requirement that the clay should be turned between February 1 and the time of moulding of the bricks. The reduction or, in some cases, entire elimination of the time of weathering of the raw clay, together with the speeding-up of drying and other processes, have created many new technical problems. The large-scale production of burnt clay products demands, therefore, if it is to be conducted on economic lines, a degree of control both of materials and processes which was quite foreign to the older small-scale industry.

The mineralogy of raw clay has made striking advances in recent years, but the chemical changes which occur on burning are still a matter of controversy. Plasticity, that physical property by which clays are characterized, remains a much confused subject. In many of the experimental methods used for its determination in the clay industry, properties other than plasticity enter and a return to methods which are fundamentally simple, such as the measurement of deformation in torsion or tension, appears necessary. Problems of drying play a large part in manufacture, and most manufacturers use unnecessarily long drying periods as an insurance against losses by cracking. This could be avoided by the application of adequate knowledge of the properties of a clay. The temperature of drying is important, there being a temperature at which the safe rate of drying is a maximum; the tendency to crack is greater above and below this temperature. It appears that the decrease in viscosity of water with rise in temperature is offset at the higher temperatures by the decrease in the tensile strength of the clay. F. M. L.

The British Association and the Indian Science Congress

A Scientific Delegation to India

ARRANGEMENTS for a scientific delegation from Great Britain to India this winter are nearing completion. The Indian Science Congress Association, which holds annual meetings in different parts of India of individual scientific workers and others, and functions much on the lines of the British Association for the Advancement of Science, is approaching the celebration of its jubilee (twenty-fifth) session at the meeting to be held in Calcutta in January next. The Association invited the co-operation of the British Association in forming a representative visiting delegation from this country and others, and the General Committee of the British Association eagerly accepted the invitation, which was, in effect, to make a new use of the mechanism of the Association, and one which is felt to suggest far-reaching implications. It is common knowledge that the British Association has sometimes held its own annual meetings overseas, at the invitation of Dominion Governments and institutions. But it has never before been asked to co-operate in organizing a scientific delegation apart from its own annual meetings—and if this can be done for India, why not for other parts of the Empire in which conditions would not permit of a meeting of the Association on ordinary lines? But this is to anticipate: the present notice is concerned with the Indian meeting.

It was arranged with the Indian Science Congress Association that invitations should be extended, through and by the British Association, to a large number of eminent scientific workers in Great Britain, in part on nominations received from India, and for the rest on representative standing in the British Association. The Indian Association itself has invited certain representatives from foreign countries, and also from Great Britain in a few departments of work which find more prominent places in the Indian Association than in our own. Lord Rutherford accepted the Indian Association's request to preside over the joint congress, to the immense satisfaction of both British and Indian colleagues. The total number of the party, including delegates and persons accompanying them, is 94 at the moment of writing; but this is subject to some addition—not, it is to be hoped, to subtraction.

The programme in India is being arranged by the Indian Science Congress Association, and the presidents of the sections for the meeting are all residents in India; but the visiting delegates may be expected to take an active part in the proceedings. The meeting in Calcutta will run from January 3 until January 9, and will be preceded and followed by tours through India, during which visits will be paid to various university and other centres of scientific interest, and it is understood that some of the visiting delegates will be invited to lecture.

The great majority of the visiting party will sail on the P. and O. steamer *Cathay* on November 26 (or will overtake her at Marseilles by leaving London on December 2) and are due at Bombay on December 16. Two days will be devoted there to reception and sight-seeing, and the party will then leave in a special train or trains in which they will live, strenuously no doubt but in the best of comfort which the Indian railways can provide, for the next twelve days. In the course of this journey they will visit Hyderabad (by the special invitation of the Nizam's Government), Agra, Delhi, Dehra Dun, and Benares, besides intermediate points of interest, where scientific and university institutions in particular will be inspected. There will be some opportunity for short journeys from Calcutta before the meeting of the Congress, including field excursions to the coalfields, Tatanagar, Darjeeling, ancient 'Gaur', the Sundarbans and the Assam oilfields, and after the meeting a further tour is planned to include Madras and Bangalore. Many of the delegation, however, having special interests and contacts in India, will substitute for this second tour individual visits to various places, and full facilities will be given to them to do so. Nor will the whole party be gathered together for the homeward voyage, though a substantial proportion of it will return from Bombay on the S.S. *Strathaird*, which will bring passengers to England on February 3, or a few days earlier by the overland journey from Marseilles.

The fund necessary in connexion with this occasion has been raised partly by the Indian Association, partly by the British Association from interested firms and individuals at home, and partly by means of a contribution from the funds of the British Association itself, which last is additional evidence, if any were needed, of the full appreciation of the importance of the occasion by the Council and General Committee of the senior body, as well as of the high compliment paid to it by the Indian Association in inviting its co-operation.

Obituary Notices

Prof. V. L. Kellogg

IN the death of Vernon Lyman Kellogg, which took place at Hartford sanitorium (Conn.) on August 8 last, the United States loses an eminent citizen and one who was a leading figure in the scientific life of that country. Born at Emporia, Kansas, in 1867, he graduated at the University of Kansas in 1889 and at Cornell University in 1891. His academic training was primarily as a zoologist and was continued in Paris and in Leipzig.

Although a man of broad zoological interests, Kellogg's scientific papers were almost entirely concerned with entomology. For a few years he taught that branch of the subject at Kansas University and afterwards he became professor of entomology and lecturer in bionomics at Stanford University. In 1908 he married Miss Charlotte Hoffman of Oakland, California. During his long period of tenure at Stanford, he was closely associated with the late David Starr Jordan, in collaboration with whom he wrote several books on diverse aspects of general zoology.

Kellogg's career at Stanford University virtually came to an end with the advent of the Great War. It was through the influence of Herbert Hoover that Kellogg was seconded for work in connexion with the American Relief Commission in Europe. Here his organizing capacity found scope, and he rapidly came into prominence owing to the leading part he performed in the Commission's activities. From 1917 until 1919 he was director in Brussels of this Commission for Belgium. His labours, on behalf of the benevolent efforts made by the United States, took him also to Poland and to Russia. The services which he rendered in organizing relief and other measures, during and after the War, received recognition by the bestowal upon him of decorations by France, Belgium and Poland.

On returning to the United States, Kellogg resigned his position at Stanford University, which he had held from 1894 until 1920. He had lately become permanent secretary of the National Research Council, an office which he administered until he retired from the post at the end of 1931. Kellogg's main interests were no longer in academic work, and he embarked upon what had been described as his period of greatest influence and accomplishment. In his capacity as secretary he played a major part in organizing the National Research Council. Being also a member of the National Academy of Sciences, a trustee of the Rockefeller Foundation and a member of its executive committee, and of other bodies, he was able to do much towards moulding the trend of scientific activities in America. Prof. R. A. Millikan, writing in *Science* of September 3, recounts that about 1930 Kellogg found himself to be the victim of an incurable malady known as Parkinson's disease (paralysis agitans). The fortitude with which he faced this sentence, with unimpaired mind and failing body, won the admiration of personal friends. He only missed by a few months attaining his seventieth birthday.

Kellogg's contributions to entomology were in taxonomy and anatomy. For a number of years he was the leading authority on bird parasites or Mallophaga. His other papers were chiefly concerned with the structure of Diptera, and he also made a special study of the family Blepharoceridæ and their larvæ. His monograph on this group, and also that on the Mallophaga, formed parts of the "Genera Insectorum". His writings also include anatomical and other articles on Lepidoptera. Most of his papers were short, but they usually brought to light new or interesting features. His books were of a more general character and included "American Insects", 1904; "Evolution and Animal Life" (with D. S. Jordan), 1907; "Darwinism To-day", 1907; "Economic Zoology and Entomology" (with R. W. Doane), 1915; "Mind and Heredity", 1923; "Evolution", 1924, and several others.

During the War years, and shortly afterwards, Kellogg wrote various books of a different character—they were incidental to that upheaval in Europe and had particular reference to its political and economic outcome. These writings made his name familiar among his countrymen as that of a notable exponent of those times. A. D. IMMS.

Mr. F. C. Thompson

FREDERICK CHARLES THOMPSON, lecturer in the Leather Industries Department and research assistant in the Procter International Research Laboratory of the University of Leeds, died on September 4 at the age of forty-six years. He received his early education in a Leeds secondary school and then followed the honours course in pure chemistry at the University of Leeds, graduating in 1911. Two years later he obtained an honours degree in the chemistry of leather manufacture, and in the same year was appointed to the staff of the Leather Industries Department as assistant lecturer and demonstrator under the late Prof. H. R. Procter.

In 1913, Mr. Thompson became research assistant in the Procter International Laboratory and in 1923 was made a lecturer in the Leather Industries Department. He carried out a great variety of investigations on subjects connected with the applications of protein chemistry to leather manufacture independently and in association with Prof. H. R. Procter, Prof. D. McCandlish and Mr. W. R. Atkin, a fellow lecturer in the Department. Recently, in collaboration with Mr. Atkin, he re-wrote Procter's "Leather Chemists Pocket Book", and this revised enlarged edition is generally regarded as the standard analytical text-book for the leather chemist.

Mr. Thompson was an authority on the application to problems of the leather trade, of electrometric and colorimetric titration of reactions and was frequently consulted by workers in other branches of applied science. In recent years he collaborated with Dr. J. Gordon of the Leeds Medical School in research work upon the complex subject of immunity, where Mr. Thompson's knowledge of protein chemistry proved useful, and several joint papers have been published by them in the *British Journal of Experimental Pathology*.

Mr. Thompson enjoyed the complete confidence of his colleagues in the International Society of Leather Trades' Chemists—an organization with branches in almost every civilized country in the world. After occupying many responsible positions as chairman of commissions, he became president of the Society in 1932 and held the office for two years. One notable contribution to the work of the Society which has earned the lasting gratitude of leather chemists was made jointly with his colleague Mr. W. R. Atkin. For many years difficulty had been experienced in securing uniform supplies of hide powder, an essential material for the quantitative estimation of tannin in tanning materials used commercially. By their joint research, Thompson and Atkin established the cause of this variation and showed how it might be readily overcome. As a result of this work, far greater concordance of results is now secured in quantitative tannin analysis than was previously possible.

Mr. Thompson was a tutor of the University of Leeds, and for several years had been a member of the local committee of the Association of University Teachers. He had many interests outside university life—chief amongst them being welfare work amongst boys. He holds the record for longest continuous service with the Boys' Brigade in Leeds. Under his captaincy his Company won all the trophies open to competition, and held the battalion ambulance cup continuously for twenty-three years. For many years he was superintendent of the Burley Methodist Church Sunday School. He was interested in music and his ability as a violinist resulted in his association with several amateur orchestras. In 1919 he married Miss M. Hampshire, and she survives him.

D. McC.

Prof. A. W. Gibb

PROF. A. W. GIBB, first Kilgour professor of geology in the University of Aberdeen, died on July 12 at the age of seventy-three years.

Alfred William Gibb was born and educated in Aberdeen. After taking the degree of master of arts at the University of Aberdeen, he spent some years in teaching and in business before resuming his studies. He was one of the first to graduate at Aberdeen with the newly established degree of bachelor of science, and soon after he became assistant to the professor of natural history. In Aberdeen at this time, 1896, the teaching of geology and zoology was carried on in the one department. Fortunately, the interests of the professor, Henry Alleyn Nicholson, were keenly palæontological and his enthusiasm and care in developing the geological side of his teaching were shared by his assistant. When the late Sir J. Arthur Thomson succeeded Nicholson, he left the geology teaching entirely to Gibb. In 1908, a lectureship independent of the Natural History Department was established, and in 1922, the Kilgour chair of geology was founded. To each, in turn, Gibb was appointed, and he was responsible for the planning and development of the Department of Geology in Marischal College.

Instruction in the mineralogical and petrological aspects of geology was Prof. Gibb's personal responsibility. To this end, he spent his spare time studying with Miers and Judd, and in Heidelberg with Rosenbusch. In 1908 he was awarded a doctorate in science for a thesis describing the rocks of the basic complex of Belhelvie, and he communicated several papers on diverse aspects of local geology to the Geological Society of Edinburgh.

Prof. Gibb's main interest was his 'ordinary' class, the first-year class for arts and science students. His lectures were extraordinarily popular, vieing with those of his colleague, J. Arthur Thomson, and infecting generations of students with a vital interest in the subject which he expounded with such fascination. He had been teaching for forty years when he was forced by ill-health to retire in 1936, and the news of his death will be received with the regret that he was unable to enjoy fully the peace of his retirement.

Prof. A. Heim, For. Mem. R.S.

A CORRESPONDENT writes:

"Though his name will always be associated with his studies on Alpine structure, the part of Prof. Albert Heim as the founder of the Swiss Seismological Commission deserves to be remembered. In 1878, the first year of its existence, the Commission consisted of seven members, with Prof. A. Forster of Bern as president and Heim as secretary. To Heim was also assigned the task of collecting observations from Zurich, Uri and other cantons. Though its work was taken over in 1913 by the Swiss Meteorological Office, the Commission, re-named as the Swiss Earthquake Service, may claim to be the oldest, and by no means the least useful, of all existing committees for the study of earthquakes."

WE regret to announce the following deaths:

Major B. F. S. Baden-Powell, known for his pioneer work in aeronautics, formerly president of the Royal Aeronautical Society, on October 3, aged seventy-seven years.

Mr. Richard Inwards, a former president of the Royal Meteorological Society, on September 30, aged ninety-seven years.

Mr. Arthur Kitson, who was early associated with electric lighting and the telephone, and invented the Kitson light, among numerous other devices, aged seventy-eight years.

Prof. W. St. Clair Symmers, emeritus professor of pathology in the Queen's University, Belfast, on October 4, aged seventy-four years.

News and Views

Biometry at University College, London

FROM the beginning of the present session, Prof. J. B. S. Haldane changes his duties by taking on those of the first Weldon professor of biometry, and he is the first holder of a chair in the subject at any British university. The post was founded by a bequest left last year by Mrs. F. J. Weldon in memory of her husband, Prof. W. F. R. Weldon, who was one of the original editors of *Biometrika*. Prof. Haldane will give the first of a course of ten lectures on biometry at 5 p.m. on October 12. In 1895 Karl Pearson gave his first course on the mathematical theory of statistics at University College, when he was professor of applied mathematics and mechanics. The Biometric Laboratory originated at this time. In 1907 he took over the Eugenics Laboratory from Sir Francis Galton. On his death two years later, the latter left the residue of his estate for the founding of a professorship and Laboratory of National Eugenics and Karl Pearson became the first Galton professor. For the next twenty years, research and teaching in eugenics, statistics and biometry were carried out in the same Department, known as that of Applied Statistics. On the retirement of the director in 1933, separate departments for the first two of these subjects were instituted, and there are now chairs for all three at the College where they first obtained academic recognition.

Ionospheric Disturbances and Solar Eruptions

DR. D. F. MARTYN, Messrs. G. H. Munro and A. J. Higgs, and Dr. S. E. Williams, in a communication which appears on page 603, show evidence that a type of ionospheric disturbance accompanies every bright hydrogen solar eruption. The main features of the disturbance are an increase of ionization in the D region and a heating effect in and below the F_2 region. When the disturbances are large they cause 'fade-outs' in short-wave communication. It is concluded that these effects are due to a greatly increased emission of the hydrogen resonance line L_α from the eruptive area. This causes ionization of atomic oxygen in the D region, and dissociates the water vapour in the F_2 region, thus raising the equilibrium temperature. Further evidence of a connexion between solar activity and short-wave radio 'fade-outs' is given in the note entitled "An Active Sun-spot" on page 616 of this issue.

A New Permanent Water-Repellant for Textiles

A NEW compound of exceptional interest to both chemists and textile manufacturers is the subject of an exhibition housed at Dorland House, S.W.1, on October 5–8. This preparation, which has been given the name "Velan", has been developed during the past three years at the Manchester laboratories of Imperial Chemical Industries, Ltd., as a universal water-proofing agent for textile goods. Information concerning the chemical composition of Velan is n yet available, but it would appear to be a compl organic substance which reacts with both hydrox and amino groups and on that account is able combine with both animal and vegetable fibres. F the impregnation of textiles, Velan is used in t form of aqueous dispersions, which are readily pr parable from the substance without the aid supplementary agents. The impregnated fabrics a dried, and combination between the reagent and t textile fibres is afterwards effected by heating at temperature of 100°–150° C. It is the last stage of t process which gives permanence to the proofing.

VELAN is claimed to be the first water-repella for textiles which will remain permanent duri repeated washing, laundering and dry-cleaning pr cesses. Further, the compound is said to be uniq among proofing agents in that it imparts softne and suppleness to fabrics. Unlike rubber or cellulo lacquer waterproofings, Velan does not affect t interstices of textiles and render them impermeab to air. The proofing process has proved satisfacto with cotton, wool, natural and artificial silk, stra etc., though cotton seems to be somewhat mo satisfactory than other textiles from the point view of the permanence of the proofing. In view these advantages, and the fact that processing do not add greatly to the cost of manufacture, Vel should find a wide range of applications in the text industries.

Aid for Intellectual Unemployed in France

INTELLECTUAL workers, including men of scienc writers, artists and others, have suffered no less th industrial workers during the recent years of econom unrest. In 1934 an organization was established France with the object of providing socially usef work for the unemployed professional men a women. A list of work to be done was prepared a private donations were obtained to support t enterprise in order to see whether the idea had practical value. Thus, in 1934 and 1935 a considera number of unemployed were engaged in preparing complete list of benevolent associations existing France since 1901. The "Confédération des travailleu intellectuels", consisting of more than 200,0 workers from various professional groups, also h the problem of intellectual unemployment unc consideration. "L'Entr'aide des Travailleurs Int lectuels" (E.T.I.) was organized in order to exami the situation and to find ways and means of givi efficient assistance. The poor financial state of Fra excluded all possibility of help from the Governme and it was impossible to rely upon private donatio A campaign was therefore begun to obtain from t authorities permission to issue special stamps different values, with a small surcharge, the surcha being destined for the intellectual unemployed. T

campaign succeeded in obtaining a resolution published in the *Journal Officiel* on May 27, 1936, by which the issue of special stamps was confirmed, and the E.T.I. was entrusted with the receipt and distribution of the funds collected, under conditions drawn up by the council of the E.T.I., the Minister of National Education and the Postmaster-General.

IT was considered more useful to spend the money on work in science, literature and art, than in distributing doles, the work being carried on so long as the funds permitted under approved conditions. The work thus provided may not, of course, be adapted to the special qualifications of every unemployed person, but they are engaged for six months to do some socially useful work, unless they find employment in their own field. Up to January 1, 1937, the French Post Office paid over to the E.T.I. about a million francs under this scheme. This sum is due mainly to philatelists and stamp-dealers; for the success of the scheme, it is necessary that the public generally should take part in this social and humane work. At present the following stamps have been issued:

Fig. 1.

Letters abroad:
1 fr. 50 c. surcharge 50 c. (see Fig. 1)
Post-cards abroad:
90 c. ,, 10 c.
Internal correspondence:
50 c. ,, 10 c. and 20 c. (three kinds of stamp)
30 c. ,, 10 c.

These special stamps are available at any post office in France and at the E.T.I. (12 rue Henner, Paris IX), where they can be supplied in any quantity required.

Ancient Monuments in France

AT the close of September the Commission des Monuments Historiques of France completed a hundred years of its existence. Although at one time subjected to no little criticism, instructed and otherwise, since the War, when it has included among its members the most distinguished of French archæologists, its activities, both in the preservation and protection of buildings of historic interest and in its care for the antiquities of France generally, have deserved the highest praise. Notwithstanding limitations, of which the members of the Commission are even more fully conscious than expert opinion among the outside public, its control, advice and assistance in bringing to light, preserving and making accessible the evidence from the prehistoric sites of France, which is now a world-wide possession of archæological science, has earned the gratitude of every student of antiquity. Even better known to the travelling public, however, are the efforts which have preserved from decay and no less from vandalism the structures of the Middle Ages and of the Roman period. Among the latter the wonderful series of monuments of Roman culture, such as those at Orange, at Nîmes and at Arles, can never be forgotten by anyone who has passed through Provence. Among the latest achievements of the Commission is the excavation of the Roman theatre of Vienne, south of Lyons, which is not an amphitheatre of the more usual type, but is cut out of the side of the hill and necessitated an excavation more than sixty feet deep to bring to light the lowest tier of seats. The completion of the excavation is to be celebrated by a number of theatrical performances to be given on the stage next year similar to those now given annually in the amphitheatre at Orange.

'Shiva's Temple', Arizona

DR. HAROLD ANTHONY, leader of the Patterson-American Museum Grand Canyon Expedition, on his return to New York, gave a preliminary account of the results obtained during his four days' stay on September 16–20 on the summit of Shiva's Temple in the Grand Canyon, Arizona (see NATURE, Sept. 25, p. 537). Some seventy-five specimens, it is stated in the report in *The Times* of September 30, were shot or trapped, and will be forwarded to New York for examination. They include chipmunks, three or four species of mice, cottontail rabbits, rock squirrels, which resemble the common grey squirrel, and pack rats, of which one species may be peculiar to Shiva's Temple. As regards the problem whether isolation has produced any marked changes in appearance and habits, Dr. Anthony is of opinion that the colour of the specimens as a whole is lighter than that of those on the north and south rims of the Canyon, respectively one and a half miles and eight miles away in a straight line; but confirmation by detailed comparison is awaited. The vegetation, consisting of pines, junipers, shrubs, and cactus, is described as "more arid" than that of the mainland, and the heat as greater. The plateau, it is stated, is evidently visited in winter by cougar, or mountain lion, and coyote. As the report refers to the discovery of many Indian remains in the shape of mounds, ovens and tools, presumably the members of the expedition were not the only visitors to reach the summit since its isolation from the mainland, as was claimed originally, and the expectation of evidence bearing on the high antiquity of man in this region seems doomed to disappointment. Nevertheless, it is to be concluded that the remains are 'early', and any material which affords evidence of cultural or racial succession in the south-western States is of importance, especially in the present state of knowledge. It may be hoped that an opportunity will be found to submit the material *in situ* to careful and expert examination.

Broadcasting in India

AN outline of the policy and plans of the broadcasting organization known as All India Radio for the erection of broadcasting stations in India was given in a recent issue of the *Indian Listener*. The two main features of the problem of providing a broadcasting service in India are the relatively large area of country to be covered, and the intense atmospheric interference. It is considered to be desirable to provide as quickly as possible some sort of broadcasting service for the whole area of India, and with this object in view five short-wave transmitting equipments have been ordered and will be located at Delhi (two stations), Bombay, Calcutta and Madras. At the same time, five medium-wave stations have been ordered to provide a first-grade broadcasting service for the towns of Lahore, Lucknow, Trichinopoly, Dacca and Madras. These will supplement the existing medium-wave stations at Delhi, Bombay, Calcutta and Peshawar, so that shortly All-India Radio will have in operation five short-wave and nine medium-wave stations, the aerial power ratings of these varying from 0·25 to 10 kw. Bearing in mind that, in contrast with the practice in other countries, the short-wave stations have to provide an internal service in India, the operating wave-lengths will probably be between 30 and 50 metres for daytime and between 60 and 90 metres for night working. It is considered unlikely that there will be any interference between these stations working an internal service in India, and European and other short-wave stations operating an international service. The new medium-wave stations will operate on wave-lengths between 200 and 400 metres and will have large frequency separation so as to facilitate the provision of simple cheap receivers.

AT the present time the position with regard to broadcasting receivers in India is unsatisfactory owing to their high cost. It is considered that with the development of transmitting stations now being undertaken, there will shortly be room for three types of receiver. The first is a cheap, popular receiver suitable for local reception from the medium-wave stations. Next comes the "All-India" receiver suitable for receiving all the stations now in contemplation, and thus capable of covering the short-wave band of 30–100 metres as well as the normal medium-wave band of 200–550 metres. The third type of receiver is in the "all-wave" class generally available at the present time in Great Britain, except that it should cover wave-lengths from 13 to 100 metres without a gap. In addition, there is a demand in India for wireless receivers suitable for community reception in villages, and the Research Department of All-India Radio has already developed a special set for this purpose. No external controls are provided on this receiver, which is left tuned to the local station and is operated by a clockwork time-switch, which turns the receiver on and off at the correct time for the "village hour". The only attention required by these receivers is a visit once every three weeks to change the accumulator battery and re-wind the clock.

Origins of Clerk Maxwell's Electric Ideas

A BOOK entitled "Origins of Clerk Maxwell's Electric Ideas as described in Familiar Letters to William Thomson" has been published by the Cambridge University Press (price 3*s*. 6*d*.) These letters cover the period 1854–79 and illustrate clearly the genesis and rapid progress of Clerk Maxwell's ideas as he groped his way towards a structural theory of the electric and magnetic field. Some of the questions he asks Thomson are by no means easy to answer. In his first letter (Feb. 1854) he asks: "Suppose a man to have a popular knowledge of electrical show experiments and a little antipathy to Murphy's Electricity, how ought he to proceed in reading and working so as to get a little insight into the subject which may be of use to him in further reading?" In subsequent letters he continues to ask still more intricate questions, so doubtless Thomson's answers must have been satisfactory. In another letter he says, "I do not know the game laws and patent laws of science . . . but I certainly intend to poach among your electrical images". He fully appreciates Thomson's problem of an electrified spherical bowl. "Your bowl investigations are first-rate. I must find the induction through a round hole in a plate by means of them. Whether would you have me bag the whole thing for my book, or give results and references with an account of the method?" The letters given in this book were originally printed in Part 5 of vol. 32 of the *Proceedings of the Cambridge Philosophical Society*. As they will be of interest to many mathematical physicists, the Cambridge Press did well to publish them. Sir Joseph Larmor has edited the book.

Clean Milk and Pasteurization

DR. G. ARBOUR-STEPHENS, of 61 Walter Road, Swansea, writes, with reference to the article on the nutritive value of pasteurized milk (NATURE, 140, 389; 1937), that it is not justifiable to compromise a diminution of value in order to prevent the effects of handling by dirty people. Unfortunately, the problem is scarcely as simple as this: in spite of the greatest care and cleanliness in handling the milk, it cannot always be possible to prevent contamination from organisms which may have produced no obvious illness in the worker himself, but yet may be capable of producing illness in other people, or from organisms which may be disseminated during the incubation period of an infectious disease and before the symptoms have become obvious. To prevent otherwise unavoidable outbreaks of infectious diseases among the consumers of milk is the true function of pasteurization: it is certainly not to be considered as allowing the production of dirty milk, which can then be rendered innocuous before consumption. The aim should surely be the production of clean milk from disease-free herds, with pasteurization to obviate the ill-effects of any lapse in technique, which is bound to happen occasionally considering the many stages through which the milk has to pass under modern conditions before it reaches the consumer, or to prevent the accidental entry of virulent organisms.

Practical Aspects of Human Nutrition

THE text of a lecture entitled "The Place of Vegetables and Fruit in the Well-balanced Diet", which was delivered before the Royal Horticultural Society by Dr. G. E. Friend, is printed in the Society's *Journal* of July (62, 7, 286–295). A review of modern conceptions of the nutritional needs of the human body dealt principally with the quality of diet, rather than with quantity. Dr. Friend has charge of the health of the boys at Christ's Hospital; perhaps the members of this and similar closed communities may be regarded as adequate critics of palatability and other human aspects of diet. The nutritional value of fresh fruit and vegetables varies considerably, and but little is known about factors affecting variation. Emphasis is placed upon the necessity for co-ordinating human and plant nutrition. The best way of ensuring qualitative adequacy of protective vegetable foods is to begin with their cultivation. Soil conditions must be suitable for the production of sufficient amounts of vitamins and the minor essential elements necessary for human nutrition. Such high-grade vegetables naturally cost more to grow, and one of the problems of the future will be to convince those who hold the economic control of diet of the value of such improved produce.

The Tobacco Problem

IN an address on this subject before the Southampton Medical Society on October 6, Dr. J. D. Rolleston maintained that the tobacco habit is quite as much a concern of public health as that of acute infectious disease, a view which appears to be gaining ground in Germany, where many members of the public health service are of opinion that the harm done by nicotine is as great as that caused by alcohol. In Great Britain, however, apart from the Society for the Study of Inebriety and Drug Addiction, there has been little discussion in scientific meetings of the tobacco problem, like until recently any aspects of the sexual question. In a survey of the action of tobacco on the various systems of the body, Dr. Rolleston remarked that though in most cases little harm is likely to ensue from a mild degree of smoking, some smokers, even those of long standing, are liable to develop toxic symptoms after only a small amount of tobacco, while a considerable proportion of all tobacco consumers smoke to excess. Other subjects discussed in the address were the incidence of smoking in different countries, the relation of tobacco to cancer of the upper respiratory and alimentary tracts, tobacco in training, smoking in hospital wards, the occurrence of extensive fires due to smokers' carelessness and the formation in 1926 of the National Society of Non-Smokers.

A Philosophical Overhaul

WE have received the first chapter of a book entitled A "Philosophical Overhaul" by Oscar Ljungström, printed in English by H. Ohlsson of Lund. It is a well-written philosophical disquisition on such subjects as force, gravitation, chance, free will, causation, time, etc. It is most readable and forces one to think. The author begins "A philosopher is a doubtful man, and he puts all kinds of unnecessary questions. Not like Socrates in the forenoon, to the citizens of his own town. For if he did that nowadays they would probably turn him out with the American injunction: 'If you have nothing to do, don't do it here'. So it is safest for him to keep his doubts within his own soul, murmuring some answers to himself." The questioner has contracted the habit of writing books and so he gives the first chapter of a proposed book. He suggests that gravitation may be explained by cosmic radiation and that time cannot be measured at all. He has the merit of not being dogmatic and his suggestions are interesting and put forward modestly.

A Business Man's Library

A SELECTED list of books under the heading "A Business Man's Library" compiled by the Management Library has been issued by the National Book Council, 3 Henrietta Street, Covent Garden, London, W.C.2, from which copies may be obtained. The list covers purchasing, factory management, personnel and industrial psychology, sales management, market research, advertising, transport, general management, accountancy and statistics, commercial law, industrial biography and industrial history. While not exhaustive, it includes most of the significant recent additions to the literature of this field and is a useful adjunct to the more comprehensive "Business Man's Guide to Management", the fifth edition of which has just been published by the Management Library (23 Bloomsbury Square, W.C.1). In addition to the classified lists of books, with brief descriptive notes on their scope or contents, the latter contains a subject index, a publisher index and an author index as well as suggested courses of reading. Reference to the main divisions, general management, accounting, production, distribution, company secretary, psychology, industrial economics, in which the books are listed is facilitated by use of different coloured paper for these divisions.

Library of the American Philosophical Society

THE report on the library of the American Philosophical Society for 1936 includes details of the more important additions (Philadelphia: American Philosophical Society). Among the new exchanges of publications established during the year is one with the library of Armstrong College, Newcastle-on-Tyne. At the end of the year the Library contained 80,918 volumes, 48,468 pamphlets and 5,374 maps. The Library does not attempt to develop all fields of learning, but only those in which it is already strong or has historic interest. No expansion in modern books on medicine is contemplated owing to the existence in Philadelphia of a very important medical library, but fields in which development is intended include exploration; botany, scientific and applied; the history of science; the inter-relation of the sciences; the co-operation of learned societies and institutions. Further contributions have been made to the promotion of the Union Catalogue of Philadelphia, and the report includes a summary list of archival materials in the possession of the Library,

the most important of which is the collection of Franklin manuscripts. Much work has been carried out in preparation for the issue of a descriptive catalogue of these manuscript collections.

Smithsonian Publications

A CLASSIFIED list of Smithsonian Publications, available for distribution, August 10, 1937, compiled by Helen Monro, has been published by the Smithsonian Institution, Washington (Publication 3394). The papers are supplied only as an aid to researches or studies in which the applicant is specially interested, and accordingly applicants are required to state the grounds for their request. Except where prices are given in the list, the papers are distributed gratis. The serial publications of the Smithsonian Institution are of three types: Smithsonian Contributions to Knowledge; Smithsonian Collections; Smithsonian Annual Reports. The reports are distributed gratuitously to libraries and individuals throughout the world, but very few are now available at the Institution. The papers issued in the Contributions to Knowledge and Miscellaneous Collections are not public documents but are printed in limited editions and distributed without charge to public libraries, educational institutions and learned societies. They are supplied to other institutions and to individuals at the prices indicated.

Calendar of Chemistry

AN interesting list of names and dates has been drawn up by E. H. Huntress with the title: "Daily Chemical Anniversaries as a Teaching Tool", published in the *Journal of Chemical Education* (**14**, 328; 1937; obtainable in reprint form at a small charge). In this, each day of the year is assigned to some names of investigators distinguished for their contributions to chemistry and related sciences, who were born on that day in a year specified. The date of death is also given when the person is no longer living. In this way a valuable historical document has been produced, and it is clear from the brief introduction by the author that he has taken a great deal of trouble in collecting his material from reliable sources and in converting the dates based on different calendars to the Gregorian basis. He suggests that the list can be made use of in teaching, and it certainly offers interesting possibilities in this direction.

Game Research

APART from a few special investigations, such as that on grouse disease, little persistent attempt has been made to study the diseases of game or methods of controlling disease or increasing the health and productivity of game. The opening a few years ago of a game research estate at Knebworth by Imperial Chemical Industries Ltd. was therefore a movement of scientific as well as of sporting interest, and now a second centre has been set up at Jealott's Hill, Warfield, Berkshire, for the study of problems relating to intensive rearing and the incidence of disease. From these stations appear occasional short pamphlets dealing with the progress of research or summarizing present knowledge regarding specific diseases. Advisory Leaflet No. 12 (June 1937) deals with a few diseases of game most commonly encountered on rearing-fields and amongst wild stock, and offers some suggestions for simple treatment such as a keeper could apply. The diseases referred to are gapes, coccidiosis, cramp, pneumonia, 'sore mouth', and strongylosis or 'partridge disease'.

Partridge Mortality

THE question of "Partridge Stocks and Mortalities" is discussed in I.C.I. Game Researches, Advisory Leaflet 13, June 1937. The pamphlet is based upon information gathered from a large number of partridge manors throughout Great Britain and analysed by A. D. Middleton, of the Bureau of Animal Population. The matters discussed include losses of nests, fertility of eggs, mortality in young partridges, stock estimates, winter wastage, mortality and its reduction. The pamphlet is simply written and should be a useful guide to the shooting man and his keeper—to whom the original papers are not likely to be available—as to what may be expected amongst a normal stock of wild partridges.

Bibliography of Seismology

THE recent quarterly part of the "Bibliography of Seismology", edited by Mr. Ernest A. Hodgson, concludes the record for the year 1936 (*Pub. Dominion Observatory, Ottawa*, **12**, 1936–37). The value of the work will be evident from the fact that the number of entries for the year is 429. To a great extent, the practice of adding notes on, or abstracts of, the memoirs is abandoned. On the other hand, the useful plan of giving references to notes or articles in various scientific journals—such as NATURE, *Science*, etc., and the *Proceedings* of such bodies as the Academy of Sciences of the U.S.S.R., the Geodetic Survey of India and the Society of Petroleum Geophysicists—is extended. The countries in which earthquakes are studied are now so well represented on the list of contributors that few, if any, memoirs of importance can escape notice. The last number contains a useful subject-index under more than fifty headings.

An Active Sunspot

A LARGE and active group of sunspots, visible to the naked eye, is in transit across the sun's disk (September 28–October 11) in latitude 10° N. The date of central meridian passage was October 4·6. The following measures of area made at Greenwich and expressed in millionths of the sun's hemisphere illustrate the rapid growth of the group from September 28, when it was seen coming into view at the sun's east limb:

Sept. 28·4d	Area 450
,, 29·3	,, 1100
,, 30·4	,, 1700
Oct. 1·3	,, 2100
,, 4·4	,, 3100

By October 1, a number of separate nuclei had developed into one very long complex spot.

(*Continued on p.* 641)

NATURE

SUPPLEMENT

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Scientific Endeavour and Inferiority Complex

Recollections of My Life

By Santiago Ramón y Cajal. Translated by Prof. E. Horne Craigie, with the assistance of Prof. Juan Cano. (*Memoirs of the American Philosophical Society*, Vol. 8, Parts 1 and 2.) Part 1. Pp. xi + 272 + 13 plates. Part 2. Pp. ii + 273–638 + plates 14–21. (Philadelphia : American Philosophical Society ; London : Oxford University Press, 1937.) 22*s*. 6*d*. net.

IT is a pleasure to greet this work in an English dress. The Spanish original appeared in Madrid in 1923. A personal document, at once historical and self-revealing, it went through three editions before its author's death in 1934. For it to be accessible to a larger audience has been a desideratum for some years.

Among autobiographies of scientific men this seems likely to occupy permanently an outstanding place. It presents features, and attaches to circumstances, of exceptional interest. It comes from the pen of one who was not only a great master in his branch of science but was also a personality of rare attraction. It deals with the story of a time pregnant with change and revulsion from old ways in the writer's own country. It tells this story from its particular angle the more effectively by reason of a certain detachment from the political field, a detachment based on loftiness of view rather than on any lack of passion for his country's cause.

The microscopist on the whole is, we may think, at some disadvantage for facts in his career which shall enlist general or public interest. He has not the romance of being armed with a gigantic instrument exploring spaces and systems which by their mere enumeration leave thought staggered. His life is perforce a sedentary one with little opening for adventure. Moreover, even with the microscope, Cajal's scope of observation lay in a field not containing such exciting things as the seeds of new diseases or the specks identified as carriers of particulate heredity. It was on no such grounds as those that these "Recollections of My Life" have justified their writing. As to Cajal's scientific work, it is not always the discoverer himself who can best set forth to a lay world the broad meaning of what he has discovered. Nor do we think Cajal excels in that particular respect. Yet the book succeeds in presenting his scientific work clearly and well, though not with much gift of popular exposition. His achievement was not of a kind made easily the subject of spectacular appeal. It introduced, however, a new conception of the structure of the nervous system in its entirety and throughout.

It is probably true to say that no single observer ever yet so enlarged our knowledge of the construction of that system. His fresh conception of the structure carried with it unusually unequivocal inferences regarding certain fundamental features of its working. For physiologist and pathologist, the nervous system after Cajal's discoveries and interpretation was something so much clearer and so other than it had been as to be a system almost new, and one immensely more intelligible. That was a revolution dramatic enough to those observers technically facing the problem. But to those not so specially acquainted with it, its very technicality stood in the way of the investment of it with great general interest. The work before us has therefore, we think prudently, curtailed some of the scientific summaries and discussion, and dispenses with some of the scientific illustrations. Those parts of the work which are its truer sources of appeal and value are thus assisted rather than impaired.

One of the permanent sources of appeal in this unrestrained autobiography—for such it is—is its

frequent half-naïve, but never gratingly egotistical, resort to and exposition of its author's own views on human life and character in general, his own instance being commonly their text. These thoughts are often strikingly unsophisticated, the very reference to them somewhat of a departure from convention. At times this, like magic, turns a slight circumstance into a memorable and arresting passage for the reader. It is surely a prerogative of the Latin genius little permitted or possible to what goes by the name of Anglo-Saxon. It must have presented especial difficulty for this translation of the book. Prof. Horne Craigie has, we think, dealt with it in the best way possible. "So much of the personality of an author is contained in his very diction and phraseology, that it was felt best to risk sacrificing to some extent the values of literary English in order to try to give as precise rendition as possible of each word or phrase of the original". The reader finds that this has been done with exemplary care. In result a trace of exotic character tends to attach to the text in many places, and to our thinking harmonizes with it, because it seems in keeping with something exotic to us in the author's sentiment.

One interest of the book is, and will probably for a long time increasingly be, the writer's picture of Spain, the position science and scientific medicine held there, and their social and *quasi*-political contacts in Spain during the writer's long career. Light is shed on, for one thing, an inefficiency of educational organization for science such as, whatever be the issue of the present conflict in Spain, can, so long as this book speaks, never return. The book is a self-portrayal of a heroic figure striving to regenerate his country's science and, as regards science, his country's faith in itself. It is a portrayal undertaken without vanity, and in its way free from self-consciousness. It raises before us a figure which might well serve as a symbol for a future Spain cultivating scientific achievement. We get a picture of the devoted effort of a few to re-establish in their country the cult of scientific knowledge for its own sake. The struggle depicted was against not so much any organized opposition from creed or class as against apathy under a starved educational system. Further, the national conscience had come ruefully to consent to believe that in natural science Spain was no longer to be taken seriously. An inferiority complex in respect of science sapped the nation's strength and initiative. Cajal's own contributions to research called forth from his university colleagues the remark "who is our Cajal to judge of foreign scientists!" "So deep in the vitals of our race had taken root the conviction of our sad and utter incapacity for the cultivation of Science."

Another stumbling-block for Spain, as her great master here points out, was her own language. It invests with a certain pathos some valedictory words he addressed to the young scientific Spain he had created. "One of the urgent tasks our young investigators will have is the translation into English, French or German of the essential facts discovered in our country." He had in 1897 at no small pecuniary sacrifice started a Spanish quarterly of microscopy. This with the opening of the new century became the famous *Trabajos*. But after a quarter of a century's trial he felt forced to change the title into French and to "publish the work of our laboratory in French or English". His experience was that otherwise it did not reach the scientific world; "a bitter reflection," he remarks.

Cajal had consented to be Minister of Education under a prospective term of one of the Liberal Governments. Partly at his own later request that did not come to pass. But the volume is full of reflections upon education in general and the public organization of education in Spain in particular. It is rich in reminiscence illustrating the system as it existed; he watched it in school, college and university. He lived through a period which, largely by his own example and exertion, was in some respects one of great transition. For those historians to whom the phases of history of most interest are the phases of transition, Cajal's volume provides a valuable original source. As a young student he heard vitalistic doctrines taught direct from Bordeu and the Montpellier School of the eighteenth century. Some ten years later he was facing cholera with pure cultures of the 'bacillus' and an oil-immersion lens; and he lived to find himself in a palatial laboratory abreast of the latest in the world in respect of the particular study he had made his own.

Bits of the "Recollections" were rendered into English some years ago by the accomplished medical historian Fielding Garrison, now passed away. He recognized a vein of poetry in some of Cajal's writings. It is present in this book, and with it a vein of melancholy—without that bitterness which stings in some of the aphorisms of the "Charlas de Café"—also in part at least translated by Garrison. An instance of the melancholy—and the poetical—is a passage in the last chapter of these "Recollections". Its subject is the scientific master whom old age is gripping—in fact himself at the time of his writing it. Unconsciously it challenges, by contrast, Browning's picture of Linacre in "A Grammarian's Funeral". It says, too, what Mr. Aldous Huxley, in the memorial lecture on his grandfather, said of the fate of scientific writing—but says it with a wistfulness of regret. "It is certain and even desirable

that in the course of time my insignificant personality will be forgotten; with it will doubtless perish many of my ideas. In spite of all the blandishments of self-love, the facts associated at first with the name of a particular man end by being anonymous, lost for ever in the ocean of Universal Science. The monograph impregnated with individual human quality becomes incorporated, stripped of sentiments, in the abstract doctrine of the general treatise. To the hot sun of actuality will succeed the cold beams of the history of learning." We may express this in short by saying that, as Aristotle thought of the soul, a scientific writing has no personal immortality. Yet this book will, we fancy, long have its place on the library's 'international shelf'.

Prof. Horne Craigie is to be congratulated on his work. The volume is well produced. There are a few misprints, for example, on pp. 303, 327 and 531. The book meets a distinct need.

C. S. S.

Primitive Art and Artists

The Savage Hits Back:
or The White Man through Native Eyes. By Prof. Julius E. Lips. Translated from the German by Vincent Benson. Pp. xxxi + 254. (London: Lovat Dickson, Ltd., 1937.) 21*s.* net.

AFTER this book had been written and was passing through the press, Prof. Julius E. Lips, formerly director of the Rautenstrauch-Joest Museum of Cologne, was moved to tell his readers in a foreword the circumstances of its production. Although not a Jew, his championship of freedom of thought and research brought him into conflict with the authorities and cost him his appointment. When deprived of all opportunity to continue his work and summoned to deliver up the material, which he had collected laboriously for the purpose of investigating this particular manifestation of primitive art, on the ground that it was subversive of the Nazi doctrine of Aryan supremacy—it certainly does not flatter the white man—he left his country to take refuge in Paris and later in America.

This prelude may seem irrelevant to the purpose of a study of a form of art; but it is a story which is fittingly told here. It literally shocks us into an appreciation of the fact that such masterpieces of expression and critical characterization as are shown could be produced only in an atmosphere of emotional and intellectual freedom removed *toto cœlo* from the suspicions and repressions of a totalitarian regime. The advantage lies entirely with the savage.

Prof. Lips had brought together, classified, and analysed a large number of examples of primitive art in which the artist embodied his impressions of the white men with whom he has come into contact, and also of some, though indeed not many, of the white women, as well as his conception of his distant rulers in Europe. Of these a selection is figured and discussed in this volume. Most of them, though not all, are sculptures in wood, ivory and other material. They are drawn from a wide field—Africa, Australia, Melanesia and New Guinea, the Eskimo and the Indian of the North-West Coast and South America. In time they range from the sixteenth century bronze and ivory figures of Benin art down to the present age of the motor-car. Some of the best belong to the nineteenth century. Generally, the art of the higher cultures, such as India, Japan and China, has been omitted from consideration, although some work of the Chinese has been included for purposes of comparison—a severe test, from which the primitive emerges not without credit.

When they are considered without reference to the author's purpose, these examples of primitive art are seen to attain a high standard. So far as technique and execution are concerned, they serve to illustrate the author's brief but excellent dissertation on the principles and conditions of primitive art. This dissertation, however, is more or less by way of necessary introduction to the main theme. Of the abilities of the primitive artist in his representation of that strange and in many ways mysterious being, the white man, the most striking characteristic brought out in the examples shown here is that only rarely, if at all, has there been any failure to catch and express the national particularities of the model. Englishman, Frenchman, German, Russian, whatever he may be, it is impossible to mistake what the artist intended to represent—and the likeness is more than superficial, it is a portrayal of the spirit. Here, as always, African art excels, perhaps most because of its deep-seated humour and its genius for exaggerated characterization, amounting at times to caricature. In contrast, Prof. Lips maintains that before Gauguin no European artist, with one exception, had succeeded in representing the primitive; while in travel books before the photograph, representations of natives were no more than Europeans sometimes, but not always,

decked out in the appropriate native costume and ornament. This sweeping statement is something of an exaggeration ; but it has much to support it. In these examples of African art, however, there can be no question ; and English officer, French officer, native soldiery, missionary, trader, and even the English female tourist are touched off to the life. Africa, however, has no monopoly. Russian figures from the North-West Coast are no less successful, and the masks of massacred sailors or traders from New Ireland are distressingly true to fact.

Prof. Lips, in discussing the principles which govern the approach to the study of primitive art, emphasizes the fact that such an art can exist only as a manifestation of, and in relation to, a specific culture. Incidentally, in characterizing a certain school of modern sculpture as purely African, he provides both a condemnation and a refutation of æsthetic theories which ignore the anthropological point of view. When, however, he goes on to deplore the inevitable disappearance of primitive art, as do other writers on African art for example, he is guilty, may it be said with all due respect, of a certain confusion of thought. His material must surely demonstrate this. The primitive cultures which produced it had already undergone modification by European contacts. The art, in consequence, had suffered some change, but it had neither deteriorated nor perished. Provided that it can be ensured that change in culture is organic, as for example is the aim of 'indirect rule', and not disruptive, but follows lines of development inherent in native custom and institutions, there is no reason why the capacity for artistic expression should not develop likewise, provided it is not disturbed and crippled by the introduction of alien European ideas, principles and technique. This, at least, would seem to be the lesson of the experimental introduction of native craftsmen as teachers at Achimota.

Finally, it may be said that this is a book which no student of social anthropology can afford to neglect. Apart from the light it throws on primitive art and artists, it is an illuminating study of the ways of thought of the primitive mind.

The Distribution of Animals

(1) Ecological Animal Geography

An authorized, rewritten edition based on "Tiergeographie auf œkologischer Grundlage" by Prof. Richard Hesse. Prepared by W. C. Allee and Karl P. Schmidt. Pp. xiv + 597. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1937.) 30*s*. net.

(2) Animal Communities in Temperate America : as illustrated in the Chicago Region—a Study in Animal Ecology. By Victor E. Shelford. (Geographic Society of Chicago, Bulletin No. 5.) Second edition. Pp. xiii + 368. (Chicago : University of Chicago Press ; London : Cambridge University Press, 1937.) 13*s*. 6*d*. net.

DURING the present century, the study of the distribution of animals has entered upon a new phase, marked by a more intense examination of the relationship between animals and their environment, and a desire to bring to the understanding of distribution a physiological point of view applied to communities as well as to individual species and systematic groups. As regards land animals the older works, of Murray, Wallace, Heilprin, Troussart, Beddard, Lydekker, Sclater and others, were based largely upon the knowledge of mammals and birds, and these warm-blooded animals were less obviously subject to several climatic factors which regulate the distribution of less specialized animals ; whereas, as regards marine organisms, from the time of Edward Forbes, the tendency had been to accumulate data of distribution with reference to 'zones' or other generalized areas.

The development of ecology has given a new complexion to the understanding of distribution, and although in this respect the zoologist has lagged behind the botanist, the works noticed here have consolidated the position and placed the zoologist in line for further advances.

(1) Prof. Richard Hesse's "Tiergeographie" set a new standard, with its appeal to modern methods and its weighty accumulation of examples widely drawn from zoological research papers. There has been no English work quite like it, although the posthumous volume of Dr. Marion I. Newbigin, "Plant and Animal Geography" (1936), discussed ably and in a rather less minute way some of its main topics. Since the publication of the "Tiergeographie" in 1924, however, much has been done, and the translators and joint-authors, realizing that a transcript would no longer meet the needs, have with Prof. Hesse's concurrence placed their own stamp very thoroughly upon the work. They have used their own experience and reading to revise and add, have deleted material with which they did not agree—for example, Lamarckian interpretations stuck in their gorge and were rejected—and they have increased the emphasis upon the influence of marked climatic

variations during the world's history and upon the stability of the present ocean basins. The chapter on the influence of man upon animals has been rewritten, mainly from an American point of view, and the text has been made more readable by the weeding out of Hesse's plethora of scientific names and the simplification of the scientific references. The result is a first-rate work, containing much widely gathered information, and suggesting many problems for the ecologist.

Since the original book was not reviewed in NATURE, its scope may be indicated. The greater part, in three sections comprising nineteen chapters, discusses the actual distribution of animals, in the sea (138 pp.), in inland waters (89 pp.), and on the land (180 pp.). In each case the discussion leads off with an account of the environmental factors and of their relation to animal life, and this is followed by more detailed accounts of the various communities and their structural and physiological relations to the natural conditions in which they live. Preceding these descriptive sections is a valuable introductory section of nine chapters (149 pp.) setting out the general problems and relations of ecological animal geography.

The difficulty about biological generalizations is that exceptions so often threaten to break the rule ; in other words, the factors are so complicated that clear cases seldom occur. Here the familiar zoogeographical regions of the earth's surface are condemned as abstractions, because transition areas transgress their supposed objective boundaries ; but the positive conclusion is the more helpful, namely, that "the faunal regions are divisions of the earth's surface in which the animal life bears a somewhat uniform aspect, and differs from that of the neighbouring regions in consequence of independent evolution during longer or shorter periods of isolation". When the authors, in support of Bergmann's rule that when the same species inhabits different climates the individuals tend to attain the greatest size in the coolest regions, cite (amongst others) the case of the red-deer as increasing in size towards the north-east of Europe and decreasing towards the south-west, they seem to lean upon a weak reed, for the Norwegian specimens are less than the Swedish, and both are inferior to the deer of Germany and the Carpathians ; perhaps the factor of food upsets the rule. Also, how are we to account for the fact that the distinctive forms of the sea-girt St. Kilda (oceanic climate), whether they be field-mice or house-mice or wrens, are larger than their fellows on the Scottish mainland ? It is an interesting thesis, supported by many examples and accounted for in various ways, that the extent of a region is reflected directly in the numbers of its species and even in their size.

In regard to the major facts of historical geography, the authors dismiss Wegener's theory of continental drift in a sentence ; but since the 1928 symposium which they follow, geologists have been weakening in their opposition, and the remarkable parallels drawn by du Toit between the geological formations of South America and South Africa suggest that zoologists should for the present keep an open mind.

In the bibliographies the translators have included many important works published since 1924, but admitting that rigid selection was necessary, reference might usefully have been made to C. B. Williams's "Migration of Butterflies" (1930) in connexion with the movements of insects, to Taussig's important "Ökologischen Haustiergeographie" (1932), and in connexion with inland waters to Murray and Pullar's six-volume "Bathymetrical Survey of Scottish Fresh-water Lochs" (1910), and Hora's accounts of the adaptations of animals in rapidly running streams.

The book is well printed, is illustrated by instructive and modern text-figures (although there is a wretched photograph of the gannets on the Bass Rock), and is very free from slips ("save" for have, p. 117, l. 31 ; "Agric." for Avic., p. 418 ref. 10 ; and the misleading "Baltic starfish" given as the English name for the four-bearded rockling).

Most of these points are matters of opinion, but there can be no two opinions about the value of the book itself.

(2) Shelford's "Animal Communities" has been for so many years an indispensable guide in the teaching of ecology in Great Britain that its merits do not require to be stressed. The second edition is an impression of the first, unchanged except for the correction of typographical and clerical errors, the modification of community nomenclature, and the addition of a short bibliographical appendix. But the advances of animal ecology since the original work appeared in 1912 make it odd to read the complaint that zoology has furnished geography only with data almost exclusively concerning the taxonomy and morphology of animals (p. 318) ; Hesse (not mentioned in the bibliography) and his cloud of witnesses are the answer. In the first chapter (where "Thompson" (p. 6) should be Thomson), the section on "the economic importance of animals" contains no reference to domestication.

However, the body of this pioneer work, a descriptive account of typical habitats and their communities, with occasional suggestions of the changes which both may undergo in parallel, retains its original value as an introduction to the modern method of field natural history.

JAMES RITCHIE

Communal Life Among Termites

The Soul of the White Ant

By Eugène N. Marais. With a Biographical Note by his Son and translated by Winifred de Kok. Pp. xv + 184 + 8 plates. (London: Methuen and Co., Ltd., 1937.) 7*s*. 6*d*. net.

THIS book is of considerable interest; it contains a number of original observations and there are some good plates and text figures. The original was written in Afrikaans and the translation is by Winifred de Kok.

The translator, in her preface, writes: "His years of unceasing work on the veld led Eugène Marais to formulate his theory that the individual nest of the termites is similar in every respect to the organism of an animal, workers and soldiers resembling red and white blood corpuscles, the fungus gardens the digestive organs, the queen functioning as the brain, and the sexual flight being in every respect analogous to the escape of spermatozoa and ova.

"About six years after these articles appeared (his original papers) Maurice Maeterlinck published his book "The Life of the White Ant", in which he describes this organic unity of the termitary and compares it with the human body. This theory aroused great interest at the time and was generally accepted as an original one formulated by Maeterlinck."

Marais further classes the workers as the mouth and teeth and the soldiers as the functional equivalent of the medulla oblongata; the fungus gardens as the stomach and liver, and the termitary itself as not a heap of dead earth, but as a separate animal at a certain stage of development—a composite animal in exactly the same way that man is a separate composite animal, only without the power of locomotion. By the operation of natural selection the final result will be a termitary which moves slowly over the veld! We fear we have not sufficient imagination to conjure up such a miracle. Such a theory would naturally appeal to the poetical mind of Maeterlinck; but he should at least have given Marais the credit for it.

It appears to us that the author in his endeavour to prove his theory over-reached himself, and probably thereby lost sight of a number of equally interesting facts and problems. We have seen it stated that if his facts are beyond question his theory is quite unanswerable. We do not agree with this statement; but at the same time we propose to show that in many instances what he says is incorrect.

The theory itself is only a poetical invention and gets one nowhere. One might equally well compare the termitary to the heavenly bodies, the queen being the sun, etc., and use similar arguments to try to prove it. The statement that the king and queen are ordinary four-winged *neuropterous* insects is contrary to what is known on the subject. Termites are now considered to be descended from a common ancestor to that of cockroaches, and possess some characters similar to those insects.

The queen is said by Marais to have the power of producing three different forms of insects: the queen, the worker, the soldier. As a matter of fact she can produce, as shown by Wheeler, sixteen different kinds of individuals, as follows: first-form males and females (true kings and queens); second-form males and females; third-form males and females; large male and female workers; small male and female workers; large male and female soldiers; medium-sized male and female soldiers; small male and female soldiers.

It is probable that not all these occur at once in one colony, but five or six are often to be met with in a single colony.

It is stated that all direct activity ceases in the termitary immediately the queen is destroyed, and there is an end to the community as such.

This may be the case in a small new termitary, but certainly not in a large old one. The second- and third-form adults are complemental or substitutional kings and queens, and can be used if, or when, the true queen (or king) dies. The second form have wing pads or incipient wings and perfectly formed reproductive organs, though smaller than in the first form, and the third form are entirely wingless, but possess mature reproductive organs which are smaller than in the second form.

The author says of the true kings and queens that one moment the insect is flying, a moment later the wings are detached, yet one finds no evidence of a lesion. Wheeler points out that the wings of the first-form adults break off at preformed basal sutures, and old individuals of this caste can always be recognized by the truncated wing-stubs. Marais also mentions wing-buds being sometimes present, but attributes this to atavism.

Many other instances might be brought forward, but the space at our disposal will not permit. It must be remembered that the habits of different species of termites (as with ants) differ, and the author was only observing one species.

HORACE DONISTHORPE.

Amenities of the Countryside

(1) England under Trust:
the Principal Properties held by the National Trust in England and Wales. Described and illustrated by J. Dixon-Scott. Pp. xx + 339 + 62 plates. (London: Alexander Maclehose and Co., 1937.) 7*s*. 6*d*. net.

(2) Britain and the Beast
By J. M. Keynes, H. J. Massingham, Sheila Kaye-Smith, E. M. Forster, W. A. Eden, C. E. M. Joad, John Moore, Clough Williams-Ellis, Geoffrey M. Boumphrey, R. G. Stapledon, A. G. Street, Patrick Abercrombie, Thomas Sharp, G. C. Hines, Howard Marshall, Lord Horder of Ashford, G. M. Trevelyan, John Gloag, Sir William Beach Thomas, S. P. B. Mais, R. M. Lockley, Kenneth Spence, Edmund Vale, George Scott-Moncrieff, Lord Howard of Penrith, Aileen Tatton Brown. Pp. xx + 332 + 41 plates. (London: J. M. Dent and Sons, Ltd., 1937.) 10*s*. 6*d*. net.

THE almost simultaneous publication of these two books marks an important stage in the increasing consciousness of Englishmen that they have in their countryside and their older buildings a historic heritage of incalculable value which is in danger of destruction and ought to be made secure for the enjoyment and education of their descendants. One of them is a pictorial and descriptive account of the principal properties held by the National Trust and is thus primarily a record of achievement: the other contains the views of twenty-six eminent persons on various aspects of the problem, some being content to describe, and generally to deplore, the present situation, while others put forward suggestions more or less comprehensive and more or less practical, which they would like to see adopted in a future policy.

(1) "England under Trust" contains accounts of more than fifty properties now held by the National Trust. They range geographically from Cornwall to the Roman Wall in Northumberland, and from Kent to the Lake District: in area they may be as small as Coleridge's Cottage at Nether Stowey, or as extensive as the seven thousand acres of the Holnicote Estate in Somerset. They include properties of every description—ranges of cliffs in Cornwall, an ancient hostelry in Southwark, great stretches of moorland and fell in the Lake District, historic houses like Bodiam, Tattersall, or Montacute, a complete village in Buckinghamshire, and six hundred acres of Cambridgeshire Fens.

A most encouraging feature of the record is that the Trust seems to be accumulating properties at a rate which is rapidly increasing: the number of acquisitions here illustrated which have come into its hands since 1930 is surprisingly large. It is also interesting to note that while Cornwall and the south-west generally seem to vie with the Lake District as the areas in which the Trust has been most successful in its aims, Norfolk, Yorkshire, and the north-east as a whole seem to be still almost untouched by its activities. Another fact which emerges is that the Trust now holds a considerable number of the few remaining ancient village clergy-houses; of these, the Alfriston parsonage is probably the best known, but the church houses of Widdecombe, Muchelney, and West Wycombe are all delightful buildings.

The most valuable feature of the book lies in the magnificent series of photographs by Mr. J. Dixon-Scott: every property described is illustrated by at least one of these, and both in composition and reproduction they could scarcely be bettered. It is a pity that the descriptive notes are not up to the standard of the illustrations: they are pleasantly written on the whole, but elementary grammatical errors can be found by the curious on pp. 81, 113, 147, 189, 197, 227, and 228; and it is somewhat disconcerting to find elementary historical errors also in a book the scholarship of which Prof. G. M. Trevelyan has specially commended in his foreword. The Antonine Wall, for example, was not built by Agricola (p. 24): nor did Boudicca sack Lincoln and York (p. 187), though she did sack London, which according to Mr. Dixon-Scott escaped her: nor did the Black Prince live in the fifteenth century (p. 208). In the account of Tintagel there is no mention of Mr. Radford's recent and very important excavations, which have illuminated its history far better than the shadowy Arthurian connexions, here detailed without a suggestion of doubt on their historicity. One would have hoped that a book issued under the auspices of what is after all the National Trust for Places of Historic Interest would have paid more regard to the claims of historic accuracy.

(2) "Britain and the Beast" is a thoroughly depressing book, partly because it directs attention to depressing facts with which most people are familiar (although apparently not familiar enough) and partly because its twenty-six eminent authors, in spite of ten introductory pats-on-the-back from ten even more eminent persons, have nothing approaching a common policy for improving matters. Indeed the editor, Mr. Clough Williams-Ellis, has probably been wise to let each member

of his curious team have his own say in his own way, permitting no argument with his neighbours, for if anything like a symposium, in the proper sense of that abused word, had been attempted, it would probably have developed fairly quickly into a 'rough house'. Thus C. E. M. Joad's opening assumption that the primary purpose of the countryside is to provide space for townsmen to play in, is met by A. G. Street, who asserts with some asperity that it is meant for countrymen to work in. H. J. Massingham, in a survey of English agrarian history which is little better than a caricature, believes that the big landowners have ruined the rural scene ; W. A. Eden, on the other hand, thinks that they are responsible for most of its loveliness. G. M. Boumphrey urges that a rigid line should be drawn between town and country, while Aileen Tatton Brown apparently contemplates an England which by 1987 has become one vast garden city.

Most of the writers seem to want the establishment of national parks, but they are far from agreed either on their location or their purpose. The individual contributions are of very varying length and, one may add, of very varying merit : some of the authors have really nothing to say, some have a great deal too much, and some again are so choleric that it is difficult to make out whether they have any coherent ideas at all. Among those which fall into none of these classes may be mentioned W. A. Eden's sensible and constructive account of the landowner's contribution : Sheila Kaye-Smith's interesting revelations on the economics of speculative building ; the editor's scheme for scheduling historic houses and their owners ; P. Abercrombie's practical analysis of the deficiencies of present town and country planning legislation ; K. Spence's straightforward ideas on the Lake District ; and Lord Howard of Penrith's excellent account of the amenity laws in Switzerland, Germany and Sweden ; while Sir W. Beach Thomas's translation of "Littera scripta manet" (it is very hard to get rid of printed offal) deserves a cheer all to itself.

It is a great pity that the obviously excellent photographs have been ruined by running them right over the edge of the page, leaving no margin —a modern practice which has little to commend it —and by printing them on much less satisfactory paper than is used in "England under Trust". Altogether a depressing book ; but that, after all, is presumably what its authors intended it to be.

The Growth of Modern Chemistry

A Hundred Years of Chemistry

By Prof. Alexander Findlay. (The Hundred Years Series.) Pp. 352. (London : Gerald Duckworth and Co., Ltd., 1937.) 15*s*. net.

TO write an account of the development of chemistry during the last hundred years is a task which might well daunt even the boldest spirit ; for chemistry is a major science advancing rapidly on an ever-widening front, and the period in question begins not long after chemistry had become an exact science capable of mathematical interpretation. The infusion into the body of science of a new spirit—an achievement which, in Liebig's words, constituted the immortal glory of Lavoisier—led rapidly to the formulation of that comprehensive Atomic Theory the ramifications of which form the nervous system of the wonderful body of physical science as we know it to-day.

Prof. Findlay's task has been to take up the story of chemistry soon after the birth of Dalton's theory, and to trace these ramifications in a concise and intelligible manner. Such a task calls for many qualifications. Among them may be mentioned the sixth sense of the historian, the power of critical discrimination and selection, the gift of terse expression, unending patience, a courage which never fails, and a determination to achieve the highest possible degree of accuracy. A perusal of Prof. Findlay's book will convince the most fastidious reader that the author has all these requisites.

Covering with swift strokes of his brush the limited canvas represented by some three hundred pages, our 'chymicall Artist' has produced a harmonious panorama of this century of chemistry, peopled by a rich array of pioneers of the science. As the picture grows beneath our gaze, we see how the molecular theory of Avogadro arose as an inevitable outcome of the atomic theory of Dalton ; how the molecular theory called with an increasing insistence for the development of a conception of the linking of atoms into a molecular structure ; and how, in turn, a body of seemingly irreconcilable facts led to the expansion of the two-dimensional organic molecular structure into a three-dimensional configuration, and thus to the birth of that vast sub-science of stereochemistry, which now embraces all substances. We see, further, how these successive advances

in theory were followed by an increasing command of practical technique, leading to the gradual elucidation of the constitution of natural products, to the synthesis of an enormous range of natural and artificial organic substances, and to the foundation of manifold industries based upon the new chemical knowledge.

Other strokes of this facile brush reveal how the determination of atomic weights led to the law of periodicity ; how this law "first enabled us to perceive undiscovered elements at a distance which formerly was inaccessible to chemical vision" ; how the discovery of co-ordinate families of elements indicated an identical origin ; and how, as we reach the edge of the canvas, there developed from this and other sequences the idea of the electronic constitution of matter.

Our artist depicts also the spectacular developments of physical chemistry, bringing out such high-lights as the kinetic theory of gases, the correlation of physical properties and chemical constitution, the law of mass action, catalysis, the phase rule, the theory of solutions, the ionic theory . . . and, in another field of vision, the recognition and study of radioactivity, and the development of the modern theory of atomic constitution. Truly, "the records grow unceasingly, and each new grain of truth is packed, like radium, with whole worlds of light."

The value of this bird's-eye view of the growth of modern chemistry is enhanced by the copious and accurate documentation, in the form of unobtrusive footnotes. Some of these original sources have evidently been tracked down by Prof. Findlay at a considerable cost in time and labour, as they are not to be found in the ordinary books of reference. The specialist will appreciate this feature of the book as fully as the reader with a less detailed knowledge of chemistry will enjoy the easy flow of a narrative which is of necessity somewhat condensed.

As we should expect, Prof. Findlay does not neglect the human aspect of his subject, although even here, where he might have been excusably discursive, he tempers his enthusiasm with a wise restraint. He says enough to show the reader how often one investigator seems to rise upon the shoulders of another, and how narrow is the margin which sometimes divides success from failure in chemical research work. It may also be deduced that some of the figures in this historical gallery were born under a lucky star. Thus, Pasteur's first great discovery—which laid the foundations of stereochemistry—was dependent upon the fortunate choice of a specific salt, and its crystallization below a temperature of 27° C. But chance and some auspicious star have accounted for much in the history of science, as in the social and political history of nations.

Regrettably, many of these fortuitous circumstances have passed unrecorded. It is unlikely, for example, that anybody except the present reviewer knows that the first optical resolution of a substance containing no asymmetric atom in its molecule, to which Prof. Findlay refers (p. 78), was due, in the last analysis, to the dilatory habits of a certain laboratory boy, whose inaction at a critical moment has until now remained unwept, unhonoured and unsung in the records of chemistry. And certainly nobody else knows what Sir William Pope exclaimed—when the resolution had at last been effected—at the first sight of the change in the polarimeter field : suffice it to say here that he did not repeat the English equivalent of Biot's historic utterance at the first sight of the optical rotation produced by sodium ammonium laevo-tartrate : "Mon cher enfant, j'ai tant aimé les sciences dans ma vie que cela me fait battre le cœur !"

The reflective reader may well put down this book with the query, *Quo vadis ?* "The ultimate components of matter," says Prof. Findlay (p. 261), "now appear to be two in number, the positively charged proton and the unit of negative electricity, the electron". . . . Proton and electron—positive and negative—sulphur and mercury—Sol and Luna—masculine and feminine —Yang and Yin—Osiris and Isis—sun-god and moon-goddess : what a curious appeal this doctrine of the Two Contraries has made to the human intelligence throughout the ages ! The wheel turns full circle, and the father-god and mother-goddess of the ancient civilizations reappear in the latest conception of the atom. So, too, the tail-eating snake of ancient Egypt reappeared some two thousand years later in the "Chrysopœia" of Cleopatra, and came once again in these latter days to whirl mockingly before the eyes of August Kekulé, whose fleeting vision of this ancient symbol of eternity gave birth in 1865 to the conception of the benzene ring—"the crowning achievement of the doctrine of the linking of carbon atoms".

Of chemical theory we may exclaim : "Plus ça change, plus c'est la même chose !" It is true that we have elaborated the alchemists' doctrine of the unity of matter and their sulphur-mercury theory of the constitution of metals ; and that the modern imagination has bodied forth the proton, the electron, the positron, and the neutron (this last being the latest expression of the alchemical Rebis) : but when we try to formulate the ultimate realities of matter we find them as elusive as that *ignis-fatuus* of alchemy, the Philosopher's Stone—the faith of Monday, Wednesday and Friday is the heresy of Tuesday, Thursday and Saturday. Is the path of scientific inquiry into the

fundamental nature of things fated to lead beyond the limits of human understanding into a four-dimensional world as unintelligible as the wild mysticisms of alchemy? Or will the Ouroboros Serpent, at the psychological moment, bring further enlightenment, in another vision, to some future seer of the sub-atomic world?

In these days, when an ever-increasing specialization threatens to produce a generation of chemists running in blinkers, it is hard to find an all-round master of the science who is able to see it steadily and see it whole, and to depict it in its full coherence and beauty. Prof. Findlay is such a master, and all who have the interests of chemistry at heart will be grateful to him for producing this admirable account of the growth and present state of the science.

JOHN READ.

Atomic Spectra and Atomic Structure

(1) Atomic Spectra and the Vector Model
By A. C. Candler. Vol. 1: Series Spectra. Pp. viii + 237 + 4 plates. 15*s*. net. Vol. 2: Complex Spectra. Pp. vi + 279 + 4 plates. 15*s*. net. (Cambridge: At the University Press, 1937.)

(2) Atomic Spectra and Atomic Structure
By Prof. Gerhard Herzberg. Translated with the co-operation of the Author by Prof. J. W. T. Spinks. (Prentice-Hall Physics Series.) Pp. xv + 257. (New York: Prentice-Hall, Inc.; London, Glasgow and Bombay: Blackie and Son, Ltd., 1937.) 4.25 dollars; 18*s*. 6*d*. net.

(1) MR. CANDLER'S two volumes upon atomic spectra will appeal to the spectroscopist rather than to the general reader. As the title implies, the whole work is developed on the vector model of the atom. There is a good deal to be said for a book of this nature, for the fact remains that most practical spectroscopists use the vector model in analysis and only turn to the wave mechanics solutions when vectors break down. There is, however, frequent reference to the findings of quantum mechanics, and an introductory chapter on this might well have been included. Throughout the book the historical method of approach is used, the result being an essentially empirical introduction to each branch of the subject. Both volumes contain much detailed material bearing on fundamental principles.

The first volume deals with series spectra and has a general introduction which is clearly written. A good deal of space is justifiably devoted to a very full description of the Zeeman effect, and this is followed by an excellent chapter upon atomic magnetic properties. The description of the Stark effect is rather more detailed than the accounts usually met with in a book of this nature, but this is all to the good. The chapter on the Periodic Table of the elements includes a good deal on valency and is of interest to the chemist as well as to the physicist. Extensive tables of g factors, intensities and Rydberg term values are included, with the view, apparently, of assisting the experimenter.

In the second volume, dealing with complex spectra, there is detailed consideration of individual spectra, a very wide range being covered in order to illustrate the spectral types found in the different columns of the Periodic Table. It is obvious that the author has consulted a large number of treatises and has thoroughly digested a great number of research publications, the resulting summary being certainly effective. An unusual chapter of interest is that dealing with the line absorption spectra of solids. A good chapter on intensities in line spectra has been included, but the intensities in hyperfine structures seem to have been neglected. Throughout this volume, as in the first, the value of the Zeeman effect is correctly stressed, each point of theoretical interest being supported with a wealth of experimental detail.

The chapter on hyperfine structure is not so satisfactory as the rest of the book, containing some omissions and errors. It is stated, for example, that no absolute measurements of hyperfine structure intensities have been made, but at least four papers on this subject have appeared since 1931. The nuclear spin given for iodine on p. 204 is the earlier incorrect value, and it is questionable whether the author is justified in assuming that, in even isotopes, absence of hyperfine structure means zero spin. The hyperfine structure Zeeman effect is treated with the same clearness that characterizes the description of the ordinary Zeeman effect, and a useful summary is given of the applications of observed nuclear spin properties to the theory of nuclear structure. The interesting method of deriving information about the structure of spectral terms from the study of the depolarization of resonance radiation might have been included.

The last two chapters in the book deal with forbidden transitions and with fluorescent crystals, the latter being particularly well done. Incidentally,

it is time spectroscopists adopted uniformity in the description of forbidden transitions. Mr. Candler uses the term "quadripole radiation" whilst Prof. Herzberg, in writing of the same thing, calls it "quadrupole radiation". Both notations are unfortunately in regular use.

There are many beautiful plates and diagrams in the work, which is essentially descriptive, easy to read and free from difficult mathematics. It ends with valuable lists of papers on the spectra of each atom and on the hyperfine structures in the spectra. The latter compilation is, I believe, the first of its kind to appear in print and will be found useful by the research worker. Considering the amount of material in the book, the errors are few and far between. It is an excellent treatise for spectroscopists and for investigators wishing to undertake spectroscopic work on line spectra.

(2) The book by Prof. Herzberg is a translation of his recent work "Atom Spektren und Atomstruktur" (Dresden, 1936). It is an introduction to atomic spectra and atomic theory, and is admirably suited to those physicists and chemists who wish to become acquainted with the elements of the subject. Beginning with the elementary Bohr theory of the hydrogen spectrum, the author goes on to show how the vector model breaks down as soon as the helium spectrum is considered, and proceeds to explain why the wave mechanics treatment is necessary. The introduction to the wave mechanics picture of the atom is particularly lucid and is deprived of the terrors usually associated with it in the mind of the student. Throughout the book the vector model and the quantum mechanical view are skilfully blended together into a unified description of atomic processes. A useful point is that certain more difficult paragraphs giving rather detailed wave mechanical explanations are printed in small type and can, if so desired, be avoided by the reader without destroying the continuity.

The field covered by the book is very wide. The treatment of the Zeeman effect is particularly clear, a careful balance being maintained between vector theory and wave mechanics. The Stark effect is much more briefly dealt with. It is unfortunate that the important table on p. 127 exhibiting the application of the Pauli principle has such tiny lettering that the suffixes can only be read with difficulty. Perhaps too much of chapter iv is included under small type, since, surely, all should read the important details given on series limits, perturbations and *jj* coupling. The same chapter includes a brief but very clear and precise exposition of auto-ionization. Considering the scope of the book, the chapter on hyperfine structure is reasonably complete, but again one meets the unjustifiable association of zero nuclear spin with absence of fine structure in even isotopes. This remains yet to be proved, and should be qualified in a book of an introductory nature.

The last chapter will be greatly appreciated, particularly by chemists. It deals first with atomic magnetism and then devotes a good deal of space to the applications of the known facts about atomic ionization potentials, a complete table of which is given. Amongst the subjects covered in this chapter are electron affinity, collisions of the second kind and the quantum theory of valency.

The book is illustrated by excellent diagrams and by a number of very good plates. It is only on the rarest of occasions that evidences of the German original peep through the excellent translation. This book deserves to become popular and to become widely read. Students in particular will find it a very valuable introduction which will bring them right up to the most recent developments. S. TOLANSKY.

Chemical Engineering: Position and Prospects

The Transactions of the Chemical Engineering Congress of the World Power Conference, London, June 22—June 27, 1936

Vol. 1. Pp. lxxxv+525. Vol. 2. Pp. vi+664. Vol. 3. Pp. vi+797. Vol. 4. Pp. vi+751. Vol. 5: Index. Pp. v+164. (London: Percy Lund, Humphries and Co., Ltd., 1937.) 5 vols., £12.

EIGHTY-THREE pages at the beginning of vol. 1 contain a very complete record of what took place at the first Chemical Engineering Conference of the World Power Congress, and include an account of the various functions as well as a list of the members of the Conference.

The remainder of this volume is devoted to an important subject to the chemical engineer, namely, the materials available for the construction of chemical plant. Since iron and steel still constitute the principal materials used by the engineer, the first section is devoted to this subject and the recent developments in the manufacture of ferrous alloys and their properties. In the second section of this volume are papers on the non-ferrous metals, refractory materials, stoneware, rubber, plastics, and the use of fibrous materials, all of which are used in the formation of apparatus employed in various branches of the chemical industry.

Twenty papers, all dealing with the important subject of separation in its various aspects, such as separation without change of phase or physical state, separation with change of phase or physical state, and separation involving physical reaction, form the first part of the second volume, whilst the later portion of the volume comprises three papers relating to fine grading and the estimation of finely divided solids, and eight papers on electrolysis and the production, application and development of electricity in the chemical industry.

The contents of the third volume are divided into four sections, the first of which consists of eleven papers on destructive distillation, more especially in its relation to the gas industry, as well as the blending of coals for this purpose and the correlation between the analysis of coal and its carbonization in semi-scale and industrial plants. Waste materials and the disposal of effluents form an important problem both to the industrialist and to the individual members of any community and are discussed in four papers in the first part of the next section, whilst three other papers in the second part are concerned with the production, treatment and properties of lubricating oils.

High pressures and vacua are now being more and more extensively used in industry, so it is appropriate that seven papers on these subjects should be included in the third section of this volume, in which papers on the technology of high vacua, construction of welded pressure vessels, synthesis of organic compounds, and liquid and gaseous phase reactions under high pressure are presented.

Since the addition or removal of heat is an important feature in many chemical operations, it is not surprising that the last section of this volume is given over to this subject. In the nine papers presented, such aspects as thermal compression, condensation of vapours and mixtures of vapours and gases, and other important factors connected with the application of heat in industrial problems as well as the mechanism by which the transference of heat is actually effected, have been considered.

Vol. 4 also comprises four sections, the first of which is devoted to the education and training of a chemical engineer and contains seven papers. Considerable difference in opinion has been expressed from time to time on the question of the education and duties of the chemical engineer, so that this section should prove one of the most valuable in the volume and one which should be helpful in future conferences, as it indicates the views of the leaders in this subject in those countries where classes exist for the training of industrialists of this type.

To anyone engaged in the administration of an industrial concern such subjects as efficiency, planning and control of chemical works, prevention of accidents therein and the methods of analysing the cost of a process, which form the themes of seven papers in the second section of this volume, are of interest and importance.

Under the heading of trend of development are thirteen papers upon a variety of subjects which can be broadly classified into three groups, namely, treatment of water for both steam raising and industrial purposes ; the heavy chemical industry comprising sulphuric acid manufacture, phosphatic fertilizers and the production of calcium carbide ; and thirdly, papers relating to biological processes such as fermentation, fumigation and refrigeration, all of which are included in the general term of chemical industry.

In the last section of this volume and the last session of the Congress are a group of eleven papers classified under the heading of general aspects, which can be conveniently subdivided into two subsections, namely, those papers relating to fundamental research and those to applied research. Applied research comprises the development of research laboratories by large industrial organizations, the applications of the results obtained either from fundamental or applied research to the design of chemical plant, and the investigation and study of the raw materials of a country and their utility to chemical industry. At the end of each section is a report showing the main features of each paper in that section which might form the basis for discussion, and this is followed by the discussion which took place on the papers contained in that section.

Several factors have apparently influenced the grouping of the papers, of which one of the most important was the time available for presentation and discussion, which in many instances was too short for the importance of the subject under review. The different interpretations placed upon the term chemical engineer having been to some extent clarified during this Congress, should result in the papers submitted to subsequent conferences of this kind being even more germain to the subject.

Any review of this publication would be incomplete if no mention were made of a fifth volume of one hundred and sixty-four pages which has been very carefully prepared and edited, comprising both subject and name indexes.

These books should prove a very useful addition to any library dealing with their subject, since they give world-wide views on the various aspects of a large and complex problem.

One cannot conclude without expressing appreciation of the manner in which these transactions have been printed and edited.

Corrosion of Metals

Metallic Corrosion, Passivity and Protection
By Dr. Ulick R. Evans. Pp. xxiii +720. (London : Edward Arnold and Co., 1937.) 45*s*. net.

THE importance of corrosion and protection of metals and alloys against corrosion especially to engineers, chemists and metallurgists needs no emphasis to-day. Wherever and whenever the commoner metals are used, corrosion may make its appearance. A significant feature of the study of corrosion is the enormous amount of investigation work that has been done during the past ten years. Dr. U. R. Evans has wisely taken the course of writing an up-to-date account of the subject as it stands at present in preference to revising his earlier book on "Corrosion of Metals", the last edition of which appeared in 1926.

The research work of Dr. Evans on corrosion is very well known not only to engineers and manufacturing chemists, to whom the new work is addressed, but also to the wider realms of science and technology of modern civilization. During the last ten busy years of corrosion-science, Dr. Evans has been the leader of a strong team of research workers at Cambridge, from which notable contributions to knowledge have emerged in a steady stream. For these reasons alone a new survey of the study of corrosion by Dr. Evans will be welcomed. Although fitting mention is made of Cambridge work, the author has not given undue prominence to it, but on the other hand has given a well-balanced account of his subject. The task of summarizing existing knowledge of corrosion is indeed an immense one, especially as the literature is so widely spread and so rapidly increasing in volume. No other author has attempted a work of these pretensions, and the new volume appears likely to occupy a unique position for many years to come.

The arrangement of the subject-matter is on a scientific basis. The author's aim is to unfold the facts leading to an understanding of the causes of the various types of corrosion, without which understanding the attempt to apply remedies may, as the author points out, be dangerous. There are fifteen chapters each dealing with a special aspect of corrosion or passivity. The treatment is somewhat unusual in that each chapter is divided into three sections, the first or *A* section of each being concerned with the scientific basis, the second or *B* section with practical problems, and the third or *C* section with quantitative treatment. This arrangement of the subject-matter should prove of value to readers who for various reasons are more concerned with the practical aspects than the theoretical or with quantitative aspects rather than qualitative.

Separation of the aspects of corrosion studies in this way has not prevented the author from directing attention to all points of view, achieved by presentation of very interesting subject-matter in a well-sustained manner. The reader must inevitably find himself penetrating the *B* sections even though he may have intended at first to peruse the *A* sections. This is truly a good feature and bears on the larger treatment of corrosion matter, since the subject is one which does not lend itself to empiricism. To escape the ravages of corrosion it is necessary to know not merely what is the cause but also in what manner the prevailing conditions are of influence in one way or another. In matters of corrosion, scientific treatment has ploughed stubborn ground, and those concerned with any aspect of corrosion will be the better fitted to cope with their problems the closer their acquaintance with the basic principles.

The importance of surface films on metals revealed by researches of the modern age of corrosion-study demands for them a prominent position in any treatise on corrosion, and the author appropriately devotes the opening chapters to this side of the subject. Here a useful résumé of pickling methods and results of research on pickling is well placed in view of the recent advances in pickling treatment of iron and steel, for example, to leave a protective film of phosphate on the surface with benefit to the protective effect of paints. The next chapter deals with oxidation at raised temperatures, a subject of high importance in many branches of industry.

In the next five chapters, atmospheric corrosion, tarnishing, corrosion in stagnant liquids, corrosion in moving liquids, hydrogen evolution and influence of constituents of the liquid are reviewed and discussed fully. In view of the multiplicity of factors involved and the interdependence of effects, it is not a matter of surprise that in these fields of corrosion-study different conceptions arise. In this connexion the author fittingly presents a considered statement by Bengough and Wormwell summarizing their views on corrosion of metals in salt solutions, a field in which they have made extensive researches.

The next two chapters deal with the influence of intrinsic features of metals and alloys upon corrosion. From this aspect of corrosion-study notable lines of advance have been followed to fruition, and perusal of this portion of the book

leaves the reader with an impression of the great scope for further advances as further basic knowledge is gained.

A chapter is devoted to the influence of stress and strain, and here a survey of corrosion fatigue research is given. Corrosion fatigue is one of the youngest branches of corrosion-study, and the results have been, to say the least, alarming to engineers. As in other fields, however, systematic experiments and scientific treatment are yielding information of practical value.

The rest of the book is devoted to the influence of contacts and crevices, protection by metallic coatings, protection by paints and enamels and corrosion testing, with an appendix on optical measurement of film thickness.

The book is a rich mine of information on corrosion problems and will prove of value to all chemists, engineers and metallurgists. It seems doubtful whether the binding will endure the hard use that many of the copies will surely find.

H. S.

Developments in Air Navigation

Air Navigation

British Empire edition. By Lieut.-Comdr. P. V. H. Weems, U.S.N. Edited by Arthur J. Hughes and P. F. Everitt. Pp. xiii + 490. (London: McGraw-Hill Publishing Co., Ltd.; New York: McGraw-Hill Book Co., Inc., 1937.) 30*s*.

THIS book presents clearly and systematically the theory and application of the present methods of air navigation, which form an integral part of the duties of the long-distance or 'deep sea' aviator. In the course of preparing this edition, the author has been in touch with officials of the Admiralty, Air Ministry, Imperial Airways, Air Service Training and others.

The rapidity with which the air pilot must determine his position—if it is to be of any value—has in recent years led to an overhaul of the abridged methods of the mariner, and, indeed, to the development of a school of air navigation. The fundamentals of dead reckoning and celestial navigation are common to all branches of the work, whether on land, on sea, or in the air; it is largely to the introduction of improved and abridged tables combined with the use of specialized instruments that the present advance in speed and simplicity is due. In short, the more quickly the observer must obtain his position, the more dependent has he become on the technical and instrumental side of the work. In this connexion Commander Weems has had the co-operation of Mr. A. J. Hughes, through whose public spirit the preparation of this edition is largely due.

The air pilot cannot stop on account of sudden fog or bad weather, and is thus forced to have at all times a fairly accurate knowledge of his position. For this purpose he employs pilotage, dead reckoning, radio and celestial navigation. Over stretches of uniform country, as for the mariner in open sea, pilotage may not assist, and dead reckoning is handicapped by unknown variations in the direction and force of the wind, a factor of far greater importance for the aviator than for the mariner. Position lines from radio bearings are limited by the proximity of transmitting stations, and celestial navigation is, of course, dependent on visibility, though here the aviator has some advantage over the mariner in that he can usually rise above the clouds, while his bubble sextant is independent of the sea horizon. It is due to the development of the bubble system of artificial horizon that the navigators of the air and sea are now able to observe with equal facility throughout the twenty-four hours to within 5′ or, under favourable conditions, considerably less. Improvements in the bubble sextant are in progress, and a type that will automatically register the mean of a series of six settings is under construction. To the list of observation reduction tables is to be added the forthcoming "Hughes Tables for Sea and Air Navigation", which appear to be a decided improvement on anything of their kind yet published. For air navigation time may be further saved by the use of precomputed altitudes, of which a full description is given.

Comprehensive descriptions, liberally illustrated, of all relevant instruments in use both in Great Britain and in America are found in appropriate parts of the text. The early chapters deal with charts, maps, projections, and their application to set requirements. The section on abridged methods of celestial navigation will be of particular interest to all navigators; it is perhaps as clear an introduction to this branch of the work as has hitherto been published.

The necessary, but often curtailed, explanation of the *Nautical Almanac* is further assisted by a comparison with the new *American Nautical Almanac*. In the latter is tabulated the Greenwich hour angle of the principal heavenly bodies, and

by this means the necessity for a knowledge of right ascension, sidereal time, the first point of Aries, or the equation of time is automatically eliminated.

The section on meteorology has been contributed by Dr. Sverre Petterssen, an international authority on the air mass theory.

It is a matter of opinion whether all the examples of the methods advocated are ideally chosen, and the present writer is not impressed with the nature of the star chart in the folder. Nevertheless, the book can be recommended with confidence to the aviator, navigator, or exploratory surveyor alike. G. C. F.

Theory and Practice of the Calculus

The Elements of Mathematical Analysis
By J. H. Michell and M. H. Belz. Vol. 1. Pp. xxiv + 516. Vol. 2. Pp. xii + 517–1087. (London: Macmillan and Co., Ltd., 1937.) 42*s*. net each vol.

THE authors have set themselves the task of writing a treatise on the differential and integral calculus which should be at once practical and rigorous, while assuming only the minimum of previous mathematical knowledge. The emphasis, however, is on the practical side, the book being, to quote the dust-cover, "adapted to the particular needs of students of science and engineering".

A fairly full account of the elementary theory of functions of one real variable is given, though not enough to cover the requirements of an honours degree in mathematics. Where an appeal must be made to an unproved theorem—for example, concerning differentiation of $f\{x, y(x)$ — the reader's attention is directed to the fact; and, where possible, the theorem is made to appear plausible by being proved or verified in some special case. A good feature is that in several places a strict mathematical treatment is followed by a paragraph entitled "Working Notions", in which the student is shown how loose intuitive ideas suggest or recall the result.

The presentation of the theory is, in the main, well suited to the class of students for which the treatise is intended. For example, in the main body of the work the idea of the non-terminating decimal is taken as fundamental (the Cantor theory of numbers being explained in a final chapter). This introduces very naturally the method of continued decimal subdivision to prove the fundamental theorems. One might wish, however, that this important method were rather more fully explained. Continuous functions are introduced at an early stage, and the limit of a function is dealt with by means of the easily grasped idea of potential continuity. On the other hand, the "general principle of convergence" is derived from a general discussion of limit-processes, which appears to the reviewer to be too abstract and difficult. Taylor's theorem is very well treated, losing that air of mystery which too often surrounds it. Integration is defined as the inverse of differentiation, the Riemann integral being introduced, but discussed only for a continuous integrand. Curvature, length, area and volume are dealt with rigorously but comprehensibly.

Mathematical rigour in language is usually maintained, but in one place we have "finite" for "bounded", while there seems to be a slight slip in the proof of the limit-sum integral formula. There are a few departures from standard terminology, some of which, such as the distinction between "upper barrier" and "upper bound", are good; while others, for example, "upper continuity" (for continuity on the right), seem likely to lead to confusion.

The practical side of the book is good. There are many worked examples and a large collection of problems. Maxima and minima, interpolation, Newton's method for solving an equation, and other applications of the derivative and of Taylor's theorem are thoroughly dealt with. The trigonometric, exponential and hyperbolic functions are discussed at length and used as examples of methods previously explained, while the expocyclic and epicene functions also are introduced. There is a long section on the standard forms of integrand (with recurrence formulæ), and approximate methods of integration are not neglected. Special emphasis is laid on the calculation of the uncertainty in approximations. There is a section on curves, and one on polynomial approximation by various methods. Finally, we have an introduction to differential equations, the second order equation with constant coefficients being completely discussed. It is perhaps a pity, from the practical point of view, that the authors here keep strictly to the domain of the real variable.

To sum up, the book may be recommended to all those who wish to know something of the mathematical discipline of function-theory, but whose main concern with mathematics is as a tool.

A. J. WARD.

Short Notices

Anthropology and Ethnology

A Tribal Survey of Mongalla Province
By Members of the Province Staff and Church Missionary Society. Edited by L. F. Nalder. (Published for the International Institute of African Languages and Cultures.) Pp. viii + 232. (London: Oxford University Press, 1937.) 15*s*. net.

This collective work by Government and mission officials in the most southerly part of the Anglo-Egyptian Sudan may be regarded as a supplement to the studies of C. G. and B. Z. Seligman, Driberg and Evans-Pritchard. It contains useful information, particularly about several tribes for whom hitherto there has been scarcely any published material available, and bears witness to the painstaking interest of European residents of the area in the institutions of the native peoples among whom they work. A feature of note is that nearly all the data have been collected in the vernacular.

But in view of this it is to be regretted that, except for Mr. Mynors on the Moru and Mr. Arber on the Latuka, scarcely any writer has supported his generalizations by quotation of native statements or distinguished what he actually observed from what he was told. In the absence of such empirical records, statements such as "the people's ideas [on religion] are generally very vague and unco-ordinated" or "the basis of Bari society is the clan" or "the Lango women are very liable to hysteria" are of small value. Moreover, even in matters which are comparatively easy to observe, there are many gaps in the analysis which could have been filled. In the chapter on tribal structure there is no section on family life; and the meagre summary of economic life (less than four pages) deals almost solely with technical processes, without reference to methods of productive organization and exchange.

The book has much interesting comparative material, and suggests lines for future inquiry; but it illustrates also how necessary it is nowadays that enthusiasm and hard work should be backed up by systematic anthropological training.

R. F.

Anthropology:
an Introduction to Primitive Culture. By Prof. Alexander Goldenweiser. Pp. xxi + 550 + 30 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1937.) 18*s*. net.

Prof. Goldenweiser's "Anthropology" was undertaken originally as a revision of his "Early Civilization"; but in the process of expansion it has grown into a new book. It now falls into three parts. The first, "Animals, Man and Culture", deals with man's place in Nature, and his relationship, physical and psychic, to the animal world, as well as his reactions in the development of culture; the second, "Primitive Life and Thought", discusses in twenty-two chapters culture traits, both material and social in the broader sense, in the light of specific examples as exhibited in varied cultural environments; and in the third, "The Ways of Culture", certain general problems of theoretical import are considered in four chapters on culture and environment, the spread of culture, and evolution and culture. This last section will be particularly valuable to the student. It is a well-balanced and objective examination of topics into which controversial methods are apt to introduce some, however little, distortion. A chapter on "The White Man's Burden" deals with the deplorable effects on backward peoples of contact with white civilization, and describes the efforts which are being made in the United States under the legislation of 1934 to reintegrate the tribal culture of the Indian. Prof. Goldenweiser, while generally approving the object, confesses that he is not an optimist as to the result, although the Indians have shown themselves eagerly ready to take advantage of the offers made by the Government.

Biology

Atlas of the Scale Insects of North America
By G. F. Ferris. Pp. 280 + 104 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1937.) 40*s*. net.

This is the first section of a large work undertaken by Prof. G. F. Ferris of Stanford University, who has for many years made a special study of scale insects. The author hopes eventually to deal with every species of scale insect that is definitely established in North America and to make possible their identification. The "Atlas" is primarily a collection of well-reproduced plates of admirably clear drawings illustrating each species, with brief notes on synonomy, hosts and distribution, habit, and the chief recognition characters; and the matter concerning each species can, if desired, be obtained separately in loose-leaf form.

In an interesting introduction describing the plan and basis of the work, Prof. Ferris also discusses the system of classification adopted. He considers that the old family Coccidæ "must be stepped up at least to a super-family", Coccoidea, within which he recognizes eleven families occurring in North America. Among these, the Diaspididæ is divided into the sub-families Diaspidinæ and Phœnicococcinæ, and the volume under notice deals with the tribe Diaspini of the former sub-family. This covers some 34 genera, including species of *Aulacaspis*, *Chionaspis*, *Diaspis*, *Epidiaspis*, *Lepidosaphes* and *Parlatoria*. The debatable problem of the genera to be accepted is shortly discussed, the author admitting that it "cannot be settled to the satisfaction of everyone, or perhaps even of anyone, the author included". About a hundred species in all are illustrated and, as a rough estimate, it is thought that the complete "Atlas" will include perhaps 750 species.

The difficulties of identification of scale insects are considerable, but they are a highly interesting group from the taxonomic point of view and have the added attraction that many species are of great economic importance and wide distribution as pests. In spite of this their study has been much neglected, and all who are interested will be grateful to Prof. Ferris for undertaking the valuable publication, which should prove a stimulus to further work.

Some Beautiful Indian Trees

By the late Rev. E. Blatter and Walter S. Millard. Pp. x+110+68 plates. (London: John Bale, Sons and Curnow, Ltd., 1937.) 21*s*. net.

THIS book represents the elaboration of materials already published in the *Journal of the Bombay Natural History Society*. 31 beautiful coloured plates, 35 full-plate photographs and 42 line drawings in the text of 108 pages are ample and excellent illustrations for the guidance of those who desire to acquaint themselves with some of the striking trees that are frequently met with in the plains of India. Detailed descriptions of the more common species have been given, together with notes on their distribution, economic uses and gardening. A long list of popular names has also been added. Suitable English names of some of the species have been coined. The generic name is followed by an appropriate explanatory note. The book is nicely bound and well printed.

But such rich materials lack in proper arrangement and uniformity in the treatment of families, genera and species dealt with in this volume. Such want of sequence in the subject-matter is a bit confusing to the reader. Notes on distribution might have been made more useful by incorporating further details of localities by consulting herbarium specimens of different parts of India and Burma. The lists of popular names in some cases are too long. The names of some of the species require slight modification in the light of the international rules of botanical nomenclature.

The book is entitled "Some Beautiful Indian Trees"; but some of the species dealt with are not indigenous to India.

Although there is room for several improvements in the book, yet it is indeed a laudable attempt on the part of the authors towards better recognition of some of the attractive Indian trees. The volume is a valuable addition to the Indian botanical publications. It will undoubtedly prove useful to the lovers of plants, both Indians as well as foreigners visiting India.

Mytilus

By Kathleen M. White. (Department of Oceanography, University of Liverpool: L.M.B.C. Memoirs on Typical British Marine Plants and Animals, 31.) Pp. vii+117+10 plates. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd., 1937.) 9*s*. net.

SIR WILLIAM HERDMAN did a good day's work forty years ago when he planned out for the Liverpool Marine Biological Committee the series of papers known ever since as the "L.M.B.C. Memoirs". They have put on record, in more or less detail, the structure and natural history of one common animal after another—no small service; for, as Huxley once said, if the commonest of our British animals became suddenly extinct, we should find we knew next to nothing about many of them. The writing of these memoirs has trained the prentice hand of many a naturalist, among them Ashworth and James Johnstone, Cole, Dakin, Eales, Fleure, Hickson, Imms and Punnett. A new part still comes out every now and then, and No. 31 has just appeared; it is by Miss Kathleen White of Reading, on the common mussel.

Abundance, cheapness and convenient size all fit *Mytilus edulis* for students' use, but it is not very easy to dissect—until you know how. Miss White gives a clear and full account of its anatomy, with the part on the circulatory system particularly good; her figures are excellent, and her brief instructions for dissection are very much to the point. There have been several other monographs on the mussel since de Heide wrote a book on its anatomy two hundred and fifty years ago. Seventy years ago Sabatier began an elaborate study, but never finished it; Field wrote a better and more complete one in a bulletin of the U.S. Fisheries Bureau; now Miss White has given us the best and handiest of them all.

Biology for Students of Pharmacy

By E. J. Moore. Pp. vii+415+8 plates. (London: Edward Arnold and Co., 1937.) 15*s*. net.

ELEMENTARY biology is one of the basic subjects for several types of students reading for professional degrees or diplomas such as in agriculture, medicine, dentistry, pharmacy and so forth. A general elementary course in biology should satisfy all needs, yet since most professional examining bodies set their own syllabuses, he would be an ambitious author who attempted to satisfy all requirements in one text-book.

A course which is really a combined one of botany and zoology is not the kind of biology which meets with approval to-day; but the author of this book disarms this justifiable criticism of his work by stating explicitly that "the arrangement of the chapters has been decided partly by the fact that the published syllabus [of the Preliminary Scientific Examination of the Pharmaceutical Society of Great Britain] is divided into plant and animal sections". So he wisely follows the syllabus.

This enforced failing aside, the book can be described as excellent. It is quite clear that the author takes his subject as a serious teacher and has not merely compiled his book from other publications or teaching schedules. The text is quite up to date and very lucid, and the two hundred diagrams and eight plates are so clearly produced and labelled that every student of pharmacy can be sure of getting as much out of the book as he requires.

Teachers and students of biology in the pharmaceutical departments of colleges and universities would do well to consider adopting this book as their standard.

Chemistry

Chemical Principles with particular Application to Qualitative Analysis

By Prof. John H. Yoe. Pp. ix+311. (New York: John Wiley and Sons, Ltd.; London: Chapman and Hall, Ltd., 1937.) 13*s*. 6*d*. net.

THE keynote of this book is the correlation of reactions and phenomena encountered in qualitative analysis with the student's training in the theoretical principles of inorganic and physical chemistry. All teachers recognize that qualitative analysis should form a part of the student's training, and too frequently it remains almost a separate compartment of the student's knowledge with little or no correlation with the rest of his chemical knowledge.

Prof. Yoe's book is comprehensive. There appears to be no type of reaction or physico-chemical phenomenon likely to be met with in a well-directed course of qualitative analysis but what is discussed. For example, the nature of solution, oxidation-reduction reactions, co-ordination and stereoisomeric co-ordination compounds, neutralization and hydrolysis, theory of indicators, determination of hydrogen ion concentration, the preparation and properties of colloids, adsorption phenomena, crystal structure, atomic structure and even the quantum theory are some of the topics dealt with. To most chapters there are illustrative set problems, answers being supplied to the numerical ones.

Bearing in mind the size of the book, the range of its contents is surprisingly large. In some cases the result is a lack of clarity undoubtedly due to too great compression. An example of this is the chapter on the electrical theory of matter, radioactivity and atomic structure, which occupies rather less than seven pages, in which the neutron is not specifically mentioned.

As an introduction to specialized text-books and monographs, for which all students do not have time or inclination to study, such a book as this has a useful place in the student's library. C. S. G.

Quantitative Pharmaceutical Chemistry:

containing Theory and Practice of Quantitative Analysis applied to Pharmacy. By Prof. Glenn L. Jenkins and Prof. Andrew G. DuMez. (McGraw-Hill Publications in Pharmacy.) Second edition. Pp. xxv+466. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 21*s*.

THE gratifying reception accorded to this excellent text-book on its first appearance has led the authors and publishers to issue a new edition, which has been largely revised in order to bring the subject-matter into conformity with the many changes made in the official methods of analysing pharmaceutical materials in the latest issues of the United States Pharmacopœia and the National Formulary. The theoretical matter has also been brought up to date, while the number of assay exercises has been increased. In addition, the contents have been rearranged, being now divided into three parts instead of four as in the original edition. This compression has been achieved by deleting the section on ultimate analysis and by incorporating the chapters on *p*H determinations, electro-analysis, etc., which originally represented non-official procedures, with the other physico-chemical determinations such as refractive index, specific rotation, etc. These are now all contained in Part 2, while, as before, Part 1 deals with gravimetric, volumetric and gasometric methods. The third section is devoted to special procedures such as the assay of alkaloids and volatile oils and the determination of the constants of fats, waxes, resins and balsams.

The volume is well written and produced, and although all the methods advocated are not official in Great Britain, nevertheless they will be found useful to those who are interested in the application of quantitative analysis to pharmaceutical materials.

G. R. D.

The Drama of Chemistry:

How Man deals with Atoms. By Prof. Sidney J. French. (The University Series: Highlights of Modern Knowledge.) Pp. vii+170. (New York: The University Society; London: Chapman and Hall, Ltd., 1937.) 4*s*. 6*d*. net.

IT requires confidence and wide knowledge to give a stimulating account in a small space of the work of the chemist through the ages, to discuss something of the future of the science and to suggest how a more detailed knowledge of it may be obtained. Dr. French has tackled his difficult task boldly.

The section dealing with organic and biological chemistry is not so satisfactory as those portions dealing with phenomena of solution and with atomic structure. Certain drawbacks are inevitable in a work of this kind. Formulæ of some organic compounds need revision and expansion, and the account of Pasteur's resolution of racemic acid is inaccurate. The author surely does not believe that sucrose has been synthesized, that amino acids cannot be condensed together and that Willstätter had nothing to do with the elucidation of the structure of chlorophyll!

It may also seem strange that an account of the development of our knowledge of atomic structure can be given without mentioning the names of Sir J. J. Thomson and Lord Rutherford. While later workers are referred to, Prof. F. Soddy's pioneering work on the isotopic forms of the elements is overlooked. On the other hand, "Henry Armstrong", according to Dr. French, was famous for having dared to oppose Arrhenius's dissociation theory and is described with Louis Kahlenberg as being "chief among the hardy rebels".

In spite of these criticisms, Dr. French has given us a most readable and brief account of what he aptly describes as "The Drama of Chemistry".

C. S. G.

Practical Organic Chemistry

By A. J. Mee. (Dent's Modern Science Series.) Pp. x+284. (London: J. M. Dent and Sons, Ltd., 1937.) 5*s*.

THE author has managed to compress nearly three hundred experiments into this little volume, which is intended to be used in conjunction with a text-book

dealing with the underlying theories. The aim has been to provide a course of instruction in practical organic chemistry up to pass degree standard, consisting of preparations of compounds, arranged to illustrate the main groupings of the subjects and of typical reactions of many of the prepared compounds. Two short chapters at the end deal respectively with the application of dyestuffs and the identification of unknown compounds. Quantitative analysis has been omitted. A very useful feature of the book is the inclusion at the beginning of some of the chapters of tables showing the chemical relationships of the products described.

It is rather surprising to find the old-fashioned method of drying glassware with alcohol and ether mentioned. In Fig. 16 the positions of the manometer and the safety-flask might have been interchanged and the use of rubber stoppers avoided entirely. In testing for the elements, Lassaigne's reaction with sodium often fails; Middleton's reagents (sodium carbonate and zinc dust for nitrogen and pure sugar and sodium carbonate for sulphur and the halogens) are both safer and more satisfactory. The book covers a fairly wide field and the instructions are very clear and concise.

Engineering

Aerodynamics

By Dr. N. A. V. Piercy. Pp. xvi+423. (London: English Universities Press, Ltd., 1937.) 30*s*. net.

Dr. Piercy has, to use a hackneyed phrase, "fulfilled a long felt want" in producing this book. Although there are several excellent English books on aerodynamics, the exceptional rate at which the applied outlook of the subject has developed recently has left a distinct gap in text-book literature, although such information is available in a more scattered form in periodicals, Government publications, etc. Students and professional technicians will certainly find this volume an indispensable companion.

In keeping with the breadth of his title, the author attempts to survey the whole field of his subject, and merely because of lack of space fails to do some parts of it justice. This is a pity, in a book from so able an author and unquestionable an authority as Dr. Piercy, but on the other hand the treatment is logical. Discussions start *ab initio*, and treat the subject properly up to a certain point. This makes a book that appeals to the student rather more than to the professional aerodynamicist. Is it too much to hope that this will be followed by a second volume with a more practical aspect?

Such matters as the rotating wing, interference, movements of the transmission point and the measurement of profile drag, the empirical treatment of the subject of skin friction and the boundary layer, are a few of the questions that aircraft designers need to see treated from their applied point of view. The last chapter, dealing with the analysis of performance, is exactly what is required by the practical reader, and provokes one to hope for more of this sort of treatment in either an extra volume or a second edition.

Engineering Properties of Soil

By C. A. Hogentogler, with the collaboration of Henry Aaron, Richard C. Thoreen, Edward A. Willis, and Adolph M. Wintermyer. Arranged and edited by C. A. Hogentogler. Pp. xiii+434. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 30*s*.

Soils are a subject of interest to a large circle of investigators, since they play an essential part in most human activities. Not least are they of importance to the engineer, who has to deal with them as foundations and as materials for his structures. A text-book on these aspects of their utility is therefore not only justifiable but also eminently desirable, and the authors of this joint compilation have produced one on clear and comprehensive lines. Part 1 of the volume deals with the origin and composition of soils; Part 2 with the characteristics of soil; Part 3 with the structural properties of soil; and Part 4 with practical design and construction. The chief author and his collaborators are highway engineers in the service of the United States Bureau of Public Roads: their point of view, therefore, as well as the sources of their data, is naturally mainly American, as is evidenced throughout the volume in nomenclature and classification and in the fairly extensive bibliography at the end. The book is well illustrated with diagrams, and there is a glossary of geological terms as well as a serviceable index.

B. C.

An Introduction to Fluid Mechanics

By Alex. H. Jameson. Pp. x+239. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 7*s*. 6*d*. net.

Recent developments in aeronautics, the turbine and the use of liquid and gaseous fuels have produced a great change in the science of fluid mechanics. As a consequence, an elementary knowledge of the modern advances in the subject is now required by engineering students. This book has therefore been written for the use, primarily, of second year students preparing for the London engineering degree. The author has made a special feature of keeping the course as free as possible from empirical formulæ and tables of coefficients. The text is well illustrated by clearly drawn diagrams and fully worked-out examples. Both the calculus and the method of dimensions have been used wherever necessary, and although the book is designed to cover adequately a specific syllabus, it should be very useful to all engineering students.

Storage Reservoirs

By George Bransby Williams. Pp. ix+293+24 plates. (London: Chapman and Hall, Ltd., 1937.) 25*s*. net.

Within the modest compass of 300 pages, Mr. Bransby Williams has succeeded in compressing a very comprehensive and up-to-date survey of a subject the full development of which would require a number of volumes. The survey is necessarily

brief and compact, covering as it does a wide range of topics: rainfall, off-flows (or run-offs) and storage capacities; flood discharges and spillway capacities; masonry gravity dams; single arch masonry dams; multiple arch and reinforced concrete dams; earth, hydraulic-fill and rock-fill dams; regulation of storage and reservoir features (including power stations); methods of construction and treatment of water for domestic supplies. In addition to these technical matters, the author finds space to conclude with what he terms an Engineer's Odyssey, being an account of a tour around the dams and reservoirs of Great Britain. Having occupied the post of chief engineer in the Public Health Department of the Government of Bengal, Mr. Williams naturally gives prominence to water storage installations in India, but his survey is representative of the most modern practice in other countries. There are a number of diagrams and some photographs. B. C.

Philosophy and Psychology

Theory and Art of Mysticism

By Prof. Radhakamal Mukerjee. Pp. xvi+308. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 15*s*. net.

A BOOK on Oriental mysticism—which being traditional is essentially sound—is nowadays of an actual as well as of a general interest. Europe is suffering to-day from crude and brutal mysticisms; obsessed by an apparently overpowering need of spiritual surrender; the desire for a crazy submission to 'leaders' with a false mythological halo and a perverted racial or nationalistic background. The understanding of how this mental attitude has come upon us in our Western world, what it means, and what it portends for the future, is perhaps the most vital problem of modern social science.

This book, written by one of India's foremost scholars, himself fully in sympathy with the mystical point of view, will be a great help towards the understanding of mysticism in general. The chapters which deal with the "training in the art of contemplation" will assist us in grasping the inner attitude of the mystic. Dr. Radhakamal Mukerjee has already established a world-wide reputation as an economist. He is also a distinguished scholar in social science. The width of outlook and the richness of literary and factual evidence save the work from the one-sidedness from which a piece of special pleading might suffer. The introductory chapters on the foundations of religion, on its primitive manifestations, on magic and ritual, reveal the writer's competence in dealing with anthropological problems. The discussion of the relation between religion and economic life is of special interest because here his appreciation of mysticism and his professional knowledge mingle and cross-fertilize each other. The book will therefore be of value to the student in political science, the economist, and also of course to the philosopher concerned with the history of religion.

B. M.

The Philosophy of Relativity

By Prof. A. P. Ushenko. Pp. 208. (London: George Allen and Unwin, Ltd., 1937.) 8*s*. 6*d*. net.

So many books have been written on this important subject that one may almost doubt whether anything really new can be said about it. Yet Prof. Ushenko succeeds in being both interesting and new, thanks to his method of treatment of the theory of relativity. To begin with, he wants philosophers to understand what the mathematics of relativity mean: so in Chapters ii and vi he gives a step-by-step deduction of the main equations of relativity. Then he goes on to give a critical account of the meaning of these equations. He bases his discussion on the fact that events are described by dispositional characteristics, and that they must have an essence which is distinct from these characteristics. For him, this essence is a fusion of space with time, thus rejecting physical substance as an alternative category of natural philosophy, and involving an attitude which is antagonistic to the new positivistic tendencies.

T. G.

Physics

Electrolytic Condensers: their Properties, Design and Practical Uses.

By Philip R. Coursey. Pp. viii+172+10 plates. (London: Chapman and Hall, Ltd., 1937.) 10*s*. 6*d*. net.

THOUGH the development of the electrolytic condenser goes back quite a long time, it is only in recent years—mainly through the demand of the wireless industry—that they have reached their present important position. Mr. Coursey's book is the first one published in English on this subject. It is, in the first place, intended for the prospective user, that is, for designers of apparatus incorporating such condensers.

This explains the mode of treatment adopted—in combination with the restraint which the author had to impose on himself as technical director of a firm manufacturing these condensers. We find a bare minimum of information on the physico-chemical processes underlying the action of the condenser, a general survey of the various types of construction and of their electric properties, and a fairly detailed description of the methods used for testing and of the points which have to be considered when selecting a condenser for some definite purpose. The electric properties in question are illustrated by numerous curves, many of which are characteristic; all are, however, presented in a way which makes identification with definite types of condensers or experimental conditions impossible. In order to reach as wide a public as possible a rather elementary mode of presentation has been adopted. There are few references to patents or literature, those given dealing nearly all with circuit problems.

The book will be definitely useful to the research worker who wishes to employ this type of condenser in his experimental apparatus.

A. B.

Alternating Current Measurements at Audio and Radio Frequencies

By Dr. David Owen. (Methuen's Monographs on Physical Subjects.) Pp. vii+120. (London: Methuen and Co., Ltd., 1937.) 3*s*. 6*d*. net.

THIS new addition to Messrs. Methuen's well-known series of monographs is devoted to the principal methods used for the measurement of frequency and circuit constants for alternating current in the audio and radio frequency range. Its main contents are as follow: introduction to the treatment of A.C. circuits by vector methods and complex notation, measurement of inductance (self and mutual), capacity and frequency at audio frequencies, mainly by the use of bridge methods, including, however, a special chapter on A.C. potentiometers; measurement of the same magnitudes at radio frequencies by resonance methods. The author, who with the 'Owen bridge' has himself made a definite contribution to the subject, has succeeded in presenting the matter with agreeable shortness, outlining well the points which should be observed in the experimental procedure. Numerous examples, worked out in detail, add to the usefulness of the book by illustrating the order of magnitudes and errors encountered.

A. B.

Miscellany

Interpretative History of Flight:

A Survey of the History and Development of Aeronautics, with Particular Reference to Contemporary Influences and Conditions. (Board of Education: Science Museum.) By M. J. B. Davy. Pp. 208+31 plates. (London: H.M. Stationery Office, 1937.) 5*s*. net.

THIS is a fourth volume written by Mr. Davy, of the Aeronautics Section of the Science Museum, South Kensington, which, although not directly descriptive of the exhibits there, is based upon the historical aspect of such an exhibition, and might well be read in conjunction with a visit to it.

The book describes the continuous development of the idea of flight and provides a record of the human activities leading to its achievement. The subject has been dealt with from a somewhat new point of view in that the outstanding phases, facts, and events are explained with reference to the contemporary conditions and the general trend of human development, it being felt that there exists a need for the presentation of this subject in a form which embraces more than bare facts and technical details unrelated to the social and economic background.

It is divided into three parts, and is fully illustrated with contemporary prints and photographs. Part 1 deals with the principles of natural flight and the early history of man's attempts. Part 2 treats the period from the beginning of definite historical records up to the end of the Great War in 1919, that period in which flight was first conceived, then achieved, and afterwards developed towards the wartime outlook exclusively. Part 3 covers the post-War applications to the various transport activities, and speculates upon the social and economic aspects of the question.

This is a thoroughly readable book, written by an author who is in a position to be, and is, a master of his subject.

Prosperity Beckons:

Dawn of the Alcohol Era. By Dr. William J. Hale. Pp. viii+201. (Boston, Mass.: The Stratford Co., 1936.) 2 dollars.

THE interdependence of industry and agriculture is gradually gaining wider recognition, but current conceptions of agriculture are largely dominated by inherited views of its functions. In this spirited forecast of the possibilities of an era in which alcohol will largely displace petrol and other hydrocarbons as fuel for the internal combustion engine, as a result of developments from the discoveries of Bergius on the hydration of cellulose and Hertz on the isolation of α-cellulose from wood pulp, the author discards such conceptions. The production of food, he suggests, is a purely secondary matter. A fifth of those engaged at present in agriculture could supply all our needs in respect of food and clothing. Agriculture's main business in the future should be the provision of raw materials for industry, especially raw alcohol, or as he terms it, "agricrude alcohol", and the crops to be cultivated should be determined primarily by industrial needs.

In a style which at times borrows too much from the devices if not the jargon of the publicity agent, Dr. Hale gives much food for thought, and the possibilities of advance in the direction he indicates deserve serious attention. His argument for a closer relation between the factory and the farm is reinforced not only as a contribution to the unemployment question and by the importance of utilizing the vast quantities of agricultural waste products, but also by the general tendency of economic nationalism to seek substitutes for materials imported from abroad. At a time when determined effort to formulate a genuine agricultural policy for this country related to the conservation of all its natural resources is long overdue, the book should appeal to all scientific workers who are considering the contribution of science in this field.

Noise

By Dr. A. H. Davis. (Changing World Library, No. 6.) Pp. x+148. (London: Watts and Co., 1937.) 2*s*. 6*d*. net.

THE author is well known for being in the forefront of noise studies. The present little book is suitable for the scientific worker who has not yet become acquainted with the many aspects of the noise problem, and for the general reader, who ought to be impressed by the manner in which a social problem can be attacked when treated scientifically. The measurement of noise level and the definition of the phon scale are carefully explained, but the feature of this little book is the amount of well-balanced information which is presented in such agreeable terms.

L. E. C. H.

Forthcoming Books of Science

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Clarendon Press and Oxford University Press. Practical British Forestry—C. P. Ackers.

English Universities Press, Ltd. The Vegetable Garden—W. E. Shewell-Cooper. The Herbaceous Border—R. Sudell.

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Macmillan and Co., Ltd. Green Fields: a Journal of Irish Country Life—Stephen Rynne. Cacti: a Gardener's Handbook for their Identification and Cultivation—Dr. J. Borg.

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Observations made in hydrogen light ($H\alpha$) with the Hale spectrohelioscope at Greenwich Observatory showed considerable activity within the spot. Besides the occurrence of several minor eruptions, bright eruptions of large extent were observed on September 29 at $10^h\ 50^m$ until $11^h\ 50^m$ U.T. and on September 30 at $10^h\ 28^m$ until $11^h\ 30^m$. The times of maximum intensity of these eruptions agree closely with those of pronounced fadings in short-wave wireless transmission as recorded in Great Britain and elsewhere. A magnetic disturbance was registered at Abinger from October $3^d\ 11{\cdot}3^h$ until October $4^d\ 9^h$, and an aurora was reported from the Southern Coast of England on the night of October 3–4.

Announcements

PROF. JOJI SAKURAI, president of the Imperial Academy and of the National Research Council of Japan, has been elected vice-president of the International Council of Scientific Unions in succession to the late Marchese Marconi.

GEH. MED. RAT DR. HANS VIRCHOW, emeritus professor of anatomy of the University of Berlin, celebrated his eighty-fifth birthday on September 10, and Dr. Karl Jacobj, emeritus professor of pharmacology and physiology of the University of Tübingen, was eighty years of age on September 12.

THE July issue of the *American Journal of Roentgenology and Radium Therapy* is dedicated to Dr. Henry K. Pancoast, in honour of his twenty-fifth year as professor of roentgenology at the University of Pennsylvania. Dr. Pancoast has served as president of the American Roentgen Ray Society, of the American Radium Society and of the first American Congress of Radiology held at Chicago in 1933.

MISS E. A. LANGLEY, at present organizer of school meals for the London County Council, has been appointed to fill a new post on the staff of the Board of Education as inspector of the arrangements made by local education authorities for the provision of meals. She will co-operate with the Board's medical staff in the campaign for improving the nutrition of school children.

A GRACEFUL tribute to the value of the scientific radio research conducted within the Empire has been recently paid by Mr. J. W. O. Hamilton, who has offered sums to found prizes for radio research at the Universities of Cambridge, Melbourne, Sydney and Tasmania. In his letter to the Vice-Chancellor of the University of Cambridge, offering the sum of £500 for this purpose, Mr. Hamilton has expressed a desire that the names of James Clerk Maxwell and Sir Ambrose Fleming, both Cambridge men, should be associated with the prize.

THE Quekett Microscopical Club is holding a conversazione in the rooms of the Royal Society, Burlington House, Piccadilly, W.1, on Tuesday, October 12, at 7.30.

A SPECIAL course of nine lectures will be delivered at the London School of Economics and Political Science by Bertrand Russell on "The Science of Power" on Mondays at 5 commencing October 11. Further information and forms of application may be obtained from the Secretary, London School of Economics, Houghton Street, Aldwych, W.C.2.

A CONFERENCE on Rubber Technology will be held in London on May 23–25, 1938, under the auspices of the Institution of the Rubber Industry. The president will be Mr. S. T. Rowe. The Conference will be divided into two parts: (1) Methods of Improving and Evaluating the Durability of Rubber; and (2) General Subjects. Further information can be obtained from Mr. W. F. V. Cox, Institution of the Rubber Industry, 12 Whitehall, London, S.W.1.

A GENERAL DISCUSSION on Lubrication and Lubricants, under the auspices of the engineering and technical institutions of Great Britain, is being held on October 13–15. It has been found necessary, owing to the large numbers of applications for membership, to arrange for the discussion to be held in the Central Hall, Westminster, London, S.W.1. In conjunction with the discussion an exhibition will be held at the Science Museum, South Kensington, S.W.7. The exhibits will include lubricants, bearings, applications of lubrication, filtration, testing and research, as well as an interesting series of exhibits from the Science Museum collections. The exhibition will remain open until October 31.

A CHAIR of the history of medicine has recently been founded at Buenos Aires with Prof. Juán Ramón Beltrán as its first occupant.

THE annual meeting of the International Society of Medical Hydrology, which is open to non-members, will be held at Frankfort-on-Main and the neighbouring spas on October 17–22, when the subjects for discussion will be bioclimatology, psychological factors in health resort practice and the natural history of peats and muds. Further information can be obtained from the secretary, 109 Kingsway, London, W.C.2.

THE twenty-fourth French Congress of Hygiene will be held at the Pasteur Institute, Paris, on October 18 and 19 under the presidency of Dr. E. Lesné, member of the Academy of Medicine, when the subjects for discussion, among others, will be school hygiene and wholesome milk. Further information can be obtained from Dr. R. Dujarric de la Rivière, Institut Pasteur, 28 rue du Docteur Roux, Paris 15e.

ERRATUM. Referring to his letter "Transitive Interference in Gene Linkage" in NATURE of August 21, p. 322, Prof. K. de Kőrösy writes stating that the table on p. 323 contains a misprint overlooked by him in the proof; in column *c*, line *g*, for 0·279 read 0·249.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

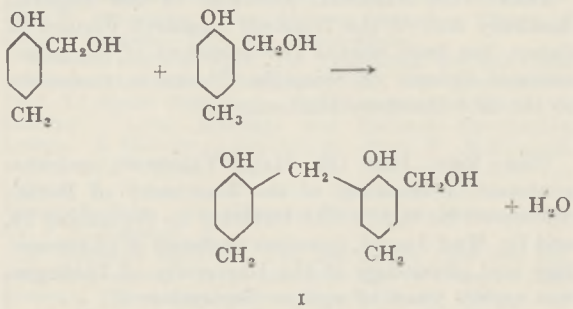
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 646.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Examination of Synthetic Resins by X-Rays

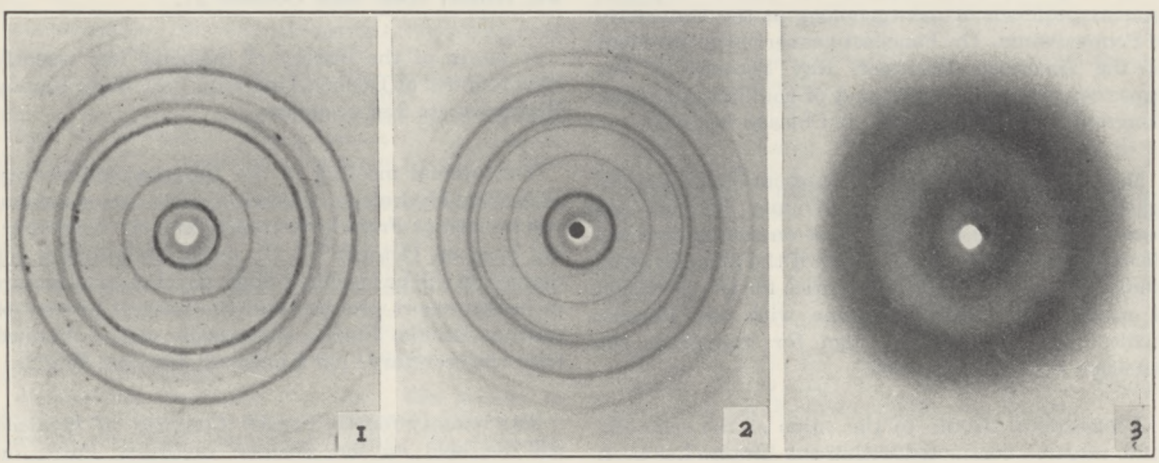
WE have attempted to study the process of resinification by following with the aid of X-ray diffraction the transitional stages of structure taking place in an initially crystalline compound which on heating forms a resin. Well-known substances of this type are the phenolic alcohols, which on heating form the class of resins termed 'saliretins'. A first result of the X-ray method has been to show that *p*-cresol monoalcohol (2-hydroxy-methyl-4-methylphenol) changes over at an intermediate stage to an apparently new compound to which this note directs attention.

The X-ray transmission spectrum of the initial material is shown in Fig. 1. After heating the substance under a pressure of 17 mm. of mercury for 30 minutes at 130°, the spectrum of the cooled product changes to that shown in Fig. 2, where the original rings, except for faint traces, are replaced by others. The new rings resemble the originals in a general way but have different diameters and, therefore, indicate a new structure. The isolation of a new compound by fractional extraction with light petroleum, from which it crystallizes in flakes melting at 99–100°, supports this conclusion. The nearness of this melting point to that of the initial material (105°) probably explains in part why the new compound has not previously been noted. The compound has tentatively been assigned the formula 3-hydroxymethyl-2 : 2′-dihydroxy-5 : 5′-dimethyl-diphenylmethane (I) (found : C, 74·8 per cent ; H, 7·29 per cent (micro-analysis) ; $C_{16}H_{18}O_3$ requires, C, 74·4 per cent ; H, 6·98 per cent). It appears to be formed as follows, and to function as a true intermediate :



I

In addition to the detection of the new compound, further X-ray results in this particular case give more definite information than usual upon the structure of the resin itself. It will be noted that the characteristic feature of Figs. 1 and 2 is a strong inner ring followed by a gap and then a group of outer strong rings. Now the spectrum of the resin taken under the same conditions, and shown in Fig. 3, shows unmistakably the same characteristics. There is a strong central halo corresponding to the inner ring of Fig. 2 and two outer halos corresponding to the outer rings of Fig. 2. The resin is, therefore, not amorphous but a distorted crystal structure with a molecular arrangement essentially similar to that of the crystalline



X-RAY DIFFRACTION PHOTOGRAPHS SHOWING THE FORMATION ON HEATING *p*-CRESOL MONOALCOHOL OF INTERMEDIATE COMPOUND AND FINAL RESIN.

intermediate. The resin is, therefore, formed structurally by small irregular relative displacements of the molecules from the crystalline formation and not by radical rearrangement of a random nature.

The size of the unit cell of *p*-cresol alcohol and the arrangement of molecules therein will be described in a more detailed communication.

This research has been carried out at the instigation of Sir Gilbert Morgan, director of the Chemical Research Laboratory, to whom thanks are due for permission to publish the results, and the X-ray work has been carried out under Dr. G. W. C. Kaye, superintendent of the Physics Department, National Physical Laboratory.

Chemical Research Laboratory (Dept. of Scientific and Industrial Research), Teddington. N. J. L. MEGSON.

National Physical Laboratory (Dept. of Scientific and Industrial Research), Teddington. W. A. WOOD.

Aug. 5.

Chemical Properties of the Rare Gases

IT is known that the rare gases argon, krypton and xenon give unstable chemical compounds with van der Waals bonds, namely, the hydrates. They have been obtained by compressing the gas over water at 0° C. In the case of argon, the crystals of the hydrate are formed at a partial pressure of argon of about 100 atm. I have already shown by an independent method[1] that radon, too, forms a hydrate which is much more stable than those of other rare gases. Radon is easily held by crystals of sulphur dioxide hydrates, when they are formed from snow and sulphur dioxide below the eutectic point or recrystallized. The radon hydrate is isomorphous with the hydrate $SO_2.6H_2O$, as its distribution between the gaseous phase and the crystal obeys the Berthelot-Nernst law: the ratio Rn/SO_2 in crystals is proportional to the corresponding ratio in the gas:

$$\frac{\text{Rn (crys.)}}{\text{SO}_2\text{(crys.)}} = D\frac{\text{Rn (gas)}}{\text{SO}_2\text{(gas)}},$$

where the constant D for Rn has the value 0·6.

I have also studied the possibility of an isomorphous 'seizure' of argon and neon by the crystals of sulphur dioxide hydrate, when formed from sulphur dioxide and snow at − 8° C. I found that argon is held by this hydrate, and could thus be transferred quantitatively from the gaseous phase into the crystals. The partition factor is constant and equal to 0·007. No neon hydrate (or any other compound of neon) is as yet known. Its dissociation pressure is presumably some thousands of atmospheres. Nevertheless, neon is also taken up by the crystals of sulphur dioxide hydrate, though with greater difficulty than argon. Only 1·2 per cent of neon goes into the crystals after passing ninety charges of sulphur dioxide into a tube containing snow and neon at − 8° C., each time about 80 per cent of the sulphur dioxide being deposited as hydrate. Under the same conditions only traces of helium, not more than 0·2 per cent, could be found in the crystals. Consequently neon, too, forms a hydrate, isomorphous with the sulphur dioxide hydrate, of the formula $Ne.6H_2O$; the constant D for neon is of the order of 0·00005.

Different stability of the rare gas hydrates makes it possible to separate them quantitatively by chemical means. After twelve depositions of sulphur dioxide as hydrate of the order of 60–70 per cent each, more than 99 per cent of radon is transferred into the crystals. By means of a current of sulphur dioxide more than 99·5 per cent of helium and neon, and about 90 per cent of argon, may be separated from crystals containing radon. For a quantitative separation of argon and radon, the hydrate must be decomposed and the separation repeated. For quantitative deposition of argon (98 per cent), 160 depositions of sulphur dioxide hydrate (80 per cent each) are needed. The whole operation lasts 8–9 hours. The depositing crystals seize, chemically and mechanically, no more than 0·5 per cent helium and about 3 per cent neon. Consequently, it is possible to separate chemically argon and radon from helium and neon, and radon from argon. It is interesting to note that the chemical properties of argon are nearer to those of radon than to neon.

B. A. NIKITIN.

State Radium Institute, Leningrad.
Aug. 26.

[1] Nikitin, B. A., *Z. anorg. allg. Chem.*, **227**, 81 (1936).

Proliferation-promoting Substances from Cells injured by Ultra-violet Radiation

As reported in this journal[1] and elsewhere[2], fractions which stimulate the growth, fermentation and respiration of yeast have been isolated in our laboratories from cells injured by ultra-violet irradiation, X-rays and other means. The following experiments by a new technique have confirmed the production of proliferation-promoting substances by cells injured by ultra-violet radiation.

Reader's medium solidified with agar was cut into blocks 3 mm. × 5 mm. × 5 mm. Dilute suspensions in Reader's medium from cultures of *S. cerevisiæ* grown on Saboraud's slants were applied to the tops of these blocks. Cover glasses were put over the inoculated areas and sealed to the blocks with agar. The materials to be tested for proliferation-promotion were added to the bottoms of the blocks, and the cover glasses and hanging blocks placed on culture slides ringed with 'Vaseline'. The cultures were incubated at room temperature for 24–48 hours. Areas of growth on the tops of the blocks were then recorded by photomicrographs. The proliferation-promoting materials diffused from the bottoms of the blocks to the cells on top, where they caused increased proliferation.

Effects of the following materials were compared: water, Reader's medium, unirradiated and irradiated yeast suspensions, cell-free fractions from unirradiated and irradiated yeast suspensions, and a highly potent bios preparation from malt combings. Yeast suspensions were prepared by adding 3·5 gm. of baker's yeast to 200 c.c. of Ringer's glucose-phosphate solution. Portions of these were irradiated in quartz test tubes, with constant stirring, by the full ultra-violet from a quartz mercury arc until about ninety per cent of the cells were killed. Cell-free fractions were usually prepared by centrifuging the suspensions for 15 minutes and decanting the supernatant fluid, occasionally by filtration through a Berkefeld filter.

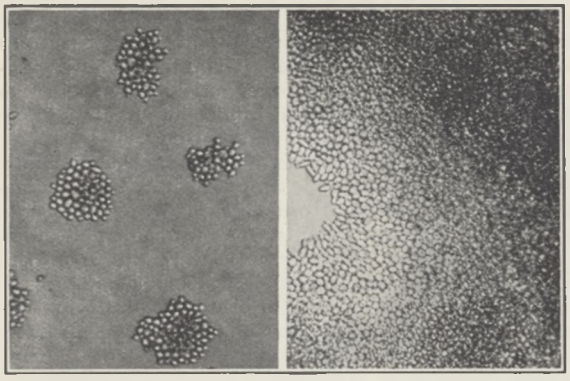
In all experiments, growth on blocks to which ultra-violet injured cell suspensions or cell-free fractions from these had been added was much greater

than on blocks to which unirradiated cell suspensions or cell-free fractions therefrom, water, Reader's medium, or nothing had been added. Bios caused approximately the same growth as the irradiated cell-free fractions. The accompanying table summarizes the results and the photomicrographs (Fig. 1) are typical of the 24-hour cultures. Addition of Reader's medium (not included in the table because it was used in only a few experiments) produced no noticeable effect. The apparent stimulation by cell-free fractions from non-irradiated cells seemed to result from mechanical injury to the cells during centrifuging.

SUMMARY OF EXPERIMENTS

Material added to bottom of block	Per cent of area on top covered with growth After 24–27 hr.	After 47–48 hr.	Dry weight of material added to block
Non-irrad. cell suspension	7·1	16·2	0·025 mgm.
Water	7·8	10·5	
Nothing	9·3	29·5	
Cell-free fraction from non-irrad. cells	14·8	no data	0·0011 mgm.
Irrad. cell suspension	30·6	70·3	0·025 mgm.
Cell-free fraction from irrad. cells	37·1	79·2	0·0038 mgm.
Kreke's bios prep. No. 14	41·4	no data	0·0037 mgm.

Ultra-violet absorption spectra of cell-free fractions from irradiated and non-irradiated cells showed considerable difference. Those of irradiated fractions were similar to the spectra of proliferation-promoting factors from yeast and irradiated liver cells reported previously[3].



(*a*) (*b*)

Fig. 1.
PHOTOMICROGRAPHS OF TOPS OF AGAR BLOCKS AFTER 26 HR. (*a*) NON-IRRADIATED CELL SUSPENSION ADDED TO BOTTOM OF BLOCK. (*b*) IRRADIATED CELL SUSPENSION ADDED TO BOTTOM OF BLOCK.

We believe the proliferation-promoting factors produced by ultra-violet injured cells afford a clue to the explanation of wound healing and possibly of certain types of malignancy, as will be discussed more fully elsewhere.

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JOHN R. LOOFBOUROW.
CECILIA MARIE DWYER.
Institutum Divi Thomae Graduate School
of Scientific Research,
Cincinnati, Ohio.
July 15.

[1] Fardon, Norris, Loofbourow and Ruddy, NATURE, **139**, 589 (1937).
[2] Fardon, Carrol and Ruddy, *Studies of the Institutum Divi Thomae*, **1**, 17 (1937). Fardon and Ruddy, *ibid.*, **1**, 41 (1937). Norris and Ruddy, *ibid.*, **1**, 53 (1937).
[3] Loofbourow, Schmieder, Stimson and Dwyer, *Studies of the Institutum Divi Thomae*, **1**, 79 (1937).

Infra-Red Spectrum of Tetradeuteroethylene

THE molecule C_2D_4 has twelve fundamental mode of vibration, of which six should be observable i Raman scattering, five in infra-red absorption, whi the remaining one must be deduced from combinatio frequencies in the infra-red or from measurements specific heat. A knowledge of those is of considerab interest in the theory of molecular vibrations (*a*) a a qualitative check on the assignment of the funda mental frequencies of the C_2H_4 molecule, (*b*) as a te of various potential functions which have bee advanced to correlate the frequencies of C_2H_4. those twelve frequencies, so far only four have bee reported, being recently observed in the Rama spectrum by de Hemptinne, Jungers and Delfosse We now wish to report briefly an investigation in th infra-red by which we have identified another fou of the twelve fundamentals.

The specimen of C_2D_4 employed was kindly give us by Prof. de Hemptinne of the University Louvain and contained about 10 per cent of C_2D_3H Strong absorption bands were found at 4·28μ, 4·56 9·28μ and 13·85μ; a weaker band was observed 6·7μ, while still weaker bands appeared at 8μ an 10·75μ. The stronger bands have all been examine under high dispersion with the exception of that 4·28μ, which practically coincides with a very stron atmospheric absorption due to carbon dioxide. Fro the contours obtained it has been possible to make th identifications indicated in the accompanying tabl The most puzzling feature is the non-appearance of th frequency ν_9. This is particularly interesting sin the corresponding frequency in C_2H_4 has usually bee supposed to coincide with ν_{11}, although it is n easy to distinguish two separate bands in the absor tion contour. One might have expected the separatio to be quite marked in the deutero-compound. W have, in fact, observed a distinct double maximum the band at 13·85μ, but it is not possible to attribu one of these to the frequency ν_9 since the latt should not possess a sharp *Q* branch. The possib explanations of this double maximum would tak too long to discuss here, and will be dealt with els where, as will also the interpretation of the weak bands.

As regards (*b*), it is interesting to compare th observed values of the infra-red frequencies wi those predicted by using the various potenti functions proposed for C_2H_4. This is done in t table.

C_2H_4	C_2D_4				
(cm.$^{-1}$)	Manneback and Verleysen[2]	Sutherland and Dennison[3]	Thompson and Linnett[4]	Bonner[5]	Observe
ν_1 2988	2153 (1·8)	2220 (1·4)	2101 (3·7)	2150 (1·8)	2192·3
ν_2 1444	1072 (0·5)	1055 (1·9)	1187 (10·3)	1071 (0·6)	1077·4
ν_3 3107	2325 (0·4)	—	2323 (0·4)	2305 (1·3)	2335±
ν_9 950(?)	678	—	1016	757	?
ν_{11} 950	—	720 (0·6)	—	505 (29)	719·5 724·7

It will be seen that discrepancies between predict and observed values (which are expressed as pe centages in brackets below each frequency) a only of the order expected through the neglect

anharmonicity (2 per cent), except in the case of two of Linnett and Thompson's, and one of Bonner's predictions. It is also noticeable that an observation of ν_9 would be another extremely helpful criterion, since here the predicted values show the widest spread. Work is being continued on the location of ν_9.

G. B. B. M. SUTHERLAND.
G. K. T. CONN.
Laboratory of Physical Chemistry,
Cambridge.
Sept. 6.

[1] de Hemptinne, M., Jungers, J., and Delfosse, J., NATURE, **140**, 323 (1937).
[2] Manneback, C., and Verleysen, A., NATURE, **138**, 367 (1936); *Ann. Soc. Scient. Bruxelles*, B, **56**, 349 (1936); **57**, 31 (1937).
[3] Sutherland, G. B. B. M., and Dennison, D. M., *Proc. Roy. Soc.*, A, **148**, 250 (1935); Sutherland, G. B. B. M., *Proc. Roy. Soc.*, A, **141**, 355 (1933) for treatment of ν_{11}.
[4] Thompson, H. W., and Linnett, J. W., *J. Chem. Soc.*, 1376 (1937).
[5] Bonner, L. G., *J. Amer. Chem. Soc.*, **58**, 34 (1936).

Physiology of Nematodes

THE initial success, or failure, of a primary infestation of a host by parasites must be largely the result of the effect on them of the environmental conditions provided by the host, conditions which must also control their distribution within the host. Unfortunately, little is known of the reactions of parasites to definite features in their environment, and in order to help relieve the paucity of our knowledge of these problems, experiments were made with nematodes from the alimentary canal of sheep.

Before the experiments could begin, it was necessary to make an attempt to settle the controversial question of the respiration of parasitic nematodes. Most workers, mainly as a result of experiments with various species of *Ascaris*, believe them to be anærobic, but I was forced to conclude that nematodes from the sheep, at least, have an ærobic existence. They are killed by periods of oxygen-lack greater than forty-eight hours, even when arrangements are made for any by-products of their metabolism which may have permeated their cuticle to be removed from their environment.

Studying the effect on the nematodes of solutions of varying *p*H, it was found that the lower limit of acidity tolerated by *Ostertagia circumcincta* (*p*H 3·2), a species normally found in the abomasum or digestive stomach of the sheep, was not low enough to allow it to live in the stomach of animals such as the dog or horse, or in the abomasum of cattle. The lower limits without adverse effect on the species from the small intestine are not low enough for them to parasitize the abomasum.

In an infestation by nematodes of the small intestine of sheep, the various species inhabit more or less definite regions, each characteristic of the species. It was found that the distance of these 'regions' from the bile duct opening could be correlated with the effect of sodium glycholate and sodium taurocholate on the different species. Thus the peaks of infestation of *Trichostrongylus colubriformis* and *T. vitrinus* occurs within about five feet of this opening, while those of *Nematodirus sp.* and *Cooperia sp.* are not within nine or ten feet of it, and it is *Trichostrongylus* which withstands the greatest concentration of bile salts.

An effort was also made to discover the food of the nematodes—the species dealt with are *Trichostrongylidæ* and are not found attached to the mucous membrane. The demonstration of hæmoglobin within them was not taken as proof of their blood-sucking habits; indeed, the evidence leads to the conclusion that nematodes of the alimentary tract synthesize this substance for themselves, presumably because it is a necessary constituent of their bodies if they are to live an ærobic existence. No definite indication of their actual food was obtained. Bacterial difficulties hampered the experiments, but in one series, when they were overcome by placing *Ostertagia* in an apparatus whereby abomasal fluid could be percolated over the worms, they lived no longer than the controls in Ringer-Locke solution. The attempts at blood-feeding with this species and with those from the small intestine also failed to keep the worms alive longer than 'starving' controls. As yet, only tentative conclusions can be drawn, but it seems that something to be found at or in the mucous membrane of the intestine, possibly the tissue itself, must be incorporated into the experiments before the culture of adult nematodes will be successful.

A full account of the experiments will be published shortly.

D. G. DAVEY.
Institute of Animal Pathology,
University, Cambridge.

Effects of Salts on Emergence from the Cyst in Protozoa

THE physiology of encystment and excystment of Protozoa and other micro-organisms has received little attention. In the case of the ciliate *Colpoda cucullus*, it has been earlier shown[1] that emergence from the cyst, or excystment, is brought about by some special substances present in the excysting medium, which is usually hay infusion. Part at least of the active material was shown to be ether-soluble. We have therefore subjected hay infusion to fractionation in order to isolate and identify the active excysting substance.

It was found unexpectedly, however, that excystment is not due to a special substance but is a property of the salts of a number of organic acids of low molecular weight. There were identified, in the ether extract of an infusion of timothy hay, oxalic, succinic, acetic, fumaric, tartaric, malic and citric acids, these being either isolated or determined by methods in the literature. The potassium salts of all these were active, to varying extents, in causing excystment. Activity is a property of the salts and not of the free acids, potassium and sodium salts being about equally active.

Since activity varies widely among the different acids, this provides perhaps the most favourable opportunity yet known for studying the relation between chemical structure and a biological activity. Preliminary results of this part of the work indicate that, in a homologous series, activity decreases with increasing molecular weight, heptylic and azelaic being the upper limits with mono- and dibasic-acids respectively. Activity is greatly increased by the presence of a hydroxy group in the β-position, but apparently decreased when it is in the α-position.

In an attempt to account quantitatively for the activity of hay infusion in terms of its content of known acids, two important modifying factors have been disclosed. First, the ether-insoluble residue considerably increases the activity of the salts of the various acids, although it possesses little activity

alone. Evidence for this phenomenon, which resembles the interaction of the bios factors in promoting yeast growth, was given earlier[1]. This action of the ether residue, we now find, may be imitated by means of a mixture of sugars and phosphate having approximately the same dry weight per cubic centimetre as the ether residue.

Secondly, some of the salts increase the apparent activity of others. In certain combinations this effect may be as large as that of the ether residue, that is, the activity is multiplied about four times. Although even *l*-malate, the most active so far found, shows little activity at the concentration at which it is present in hay infusion, nevertheless in combination with other salts the activity is considerable. A synthetic mixture of potassium salts of the various acids, each at the concentration present in hay infusion, possessed about one sixth the activity of the original infusion, but when in conjunction either with the ether-insoluble residue or with the mixture of sugars mentioned above, this figure is raised to two thirds. Several active fractions from hay infusion remain unidentified; but since the total activity of these is small compared to that of the acids already determined, it is clear that the excysting activity of hay infusion is largely explained on the above basis.

KENNETH V. THIMANN.
A. J. HAAGEN-SMIT.

Harvard Biological Laboratories,
Cambridge, Mass.
Sept. 10.

[1] Thimann, K. V., and Barker, H. A., *J. Exp. Zool.*, **69**, 37–57 (1934).

Galileo and Mathematical Demonstration

IN support of his contention that Galileo regarded mathematical demonstration as an *a priori* method of reaching truth, G. J. Whitrow, in his contribution to the supplement to NATURE of June 12[1], states that my uncle, the late Mr. J. J. Fahie, has shown that "to satisfy his [Galileo's] own mind alone he had never felt it necessary to make any [experiments]". This is a misquotation. In my uncle's book the words are[2]: "It was in reference to this controversy [on floating bodies] that Galileo declared that ignorance had been the best master he ever had, since, in order to be able to demonstrate to his adversaries the truth of his conclusions, he had been forced to prove them by such a variety of experiments as made himself doubly confident; though to satisfy his own mind alone he had never felt it necessary to make many".

WILLIAM CUSACK FAHIE.

University College,
Dublin.

[1] NATURE, **139**, 1008 (1937).
[2] Fahie, J. J., "Galileo", p. 145 (1903).

The statement in my contribution to the supplement to NATURE of June 12 is inaccurate, and I apologize for misquoting the late Mr. J. J. Fahie. Actually I did not have access to his original article and quoted from E. A. Burtt "Metaphysical Foundations of Modern Science" (2nd edition, Jan. 1932), p. 65, where, in referring to Mr. Fahie's article, the vital word 'any' is misquoted for 'many'. Until receiving Mr. Fahie's letter I was naturally unaware that Dr. Burtt had misquoted.

The point I wished to emphasize (owing to the unfortunate misquotation it was over-emphasized) is that *a priori* mathematical reasoning played a much larger part in Galileo's work than is generally realized.

G. J. WHITROW.

Christ Church,
Oxford.

Points from Foregoing Letters

X-RAY photographs indicating changes in the structure and molecular orientation of *p*-cresol monoalcohol during the process of resinification on heating are submitted by N. J. L. Megson and W. A. Wood. A new crystalline compound (m.p. 99–100°) is first formed apparently by condensation of two molecules with elimination of water. The resin which results on further heating shows signs of a distorted crystal structure, and the authors suggest that it is formed by small irregular displacements of the molecules from the crystalline formation and not by radical rearrangement of a random nature.

B. A. Nikitin states that, as in the case of radon, other rare gases, namely, argon and neon, are taken up in definite proportions by sulphur dioxide hydrate (formed from sulphur dioxide and snow at − 8° C.); he concludes that neon also forms a hydrate, as is known to be the case with argon, krypton, xenon and radon. Different stability of the rare gas hydrates makes it possible to separate chemically argon and radon from helium, and neon and radon from argon.

Photomicrographs showing the growth-stimulating effect upon yeast (*S. cerevisiæ*) of substances produced in cells irradiated with ultra-violet light are submitted by G. S. Sperti, Prof. J. R. Loofbourow and Sister C. Marie Dwyer. The authors describe a new technique of testing proliferation-producing substances, and give a table showing comparative effect of irradiated cells, Kreke's 'bios' preparation and controls.

The infra-red absorption spectrum of tetradeuteroethylene has been investigated by Dr. G. B. B. M. Sutherland and G. K. T. Conn, who have thus identified four of the fundamental frequencies of vibration of the molecule.

D. G. Davey discusses certain aspects of the physiology of nematodes from the alimentary canal of sheep. Acidity and the toxicity of bile salts are factors which influence their specificity and also their distribution within their host. He has failed to discover their actual food requirements, but points out that simple immersion in blood or alimentary canal fluid is probably insufficient for their culture *in vitro*.

Emergence from the cyst of the protozoan *Colpoda cucullus*, which takes place in hay infusion, is found by K. V. Thimann and A. G. Haagen-Smit to be due to the presence of potassium salts of certain organic acids (oxalic, succinic, acetic, fumaric, etc.). They find that the ether-insoluble portion of the hay infusion, which by itself is inactive, increased the activity of the organic salt.

Research Items

Pleistocene Relations in East Anglia and Germany

DR. FREDERICK E. ZEUNER, in support of the tentative scheme for the interpretation of the Pleistocene deposits of East Anglia put forward by Prof. P. G. H. Boswell (1932 and 1936) has instituted a comparison of these deposits and those of the Pleistocene of northern Germany (*Proc. Prehist. Soc.*, 3, 1; 1937). There is a remarkable similarity between the two series in (1) stratigraphical sequence, (2) in the palæontological evidence from the Cromer Forest Bed and that of Mosbach and Mauer, and (3) a fair agreement in the archæological sequence. In the geological evidence the correlation is as follows: (6) Scottish Readvance—Pomeranian—Würm 3; (5) Hunstanton Brown Clay—Wechsel—Würm 2; (4) Upper Chalky Boulder Drift—Warthe—Würm 1; (3) Great Chalky Boulder Clay—Saale—Riss 2; (2) Norwich Brick-earth and (?) Cromer Till—Elster—Mindel 2; (1) a possible glaciation in late Crag times—a supposed early glaciation of unknown extension—Günz. The evidence from Hoxne is the first from a British station to show a minor interglacial oscillation, which is correlated with the "Pre-Würm", or so-called warm Mousterian, of Germany between Saale and Würm 1. This implies the identification of Hoxne as Riss-Würm and not Mindel-Riss, as has been maintained by some. A comparison of the Cromer Forest Bed fauna with Mosbach and Mauer indicates that it belongs, as they do, to the Günz-Mindel interglacial, while the Crags, affording evidence both geological and palæontological of a cool climate or even of two cool subphases, may be regarded, with some reserve, as Günz. The archæological succession, beginning with Mr. Reid Moir's Crag industries as Günz, and the Chellean or Abbevillian as Günz-Mindel interglacial, while Clactonian 3 (High Lodge) is assigned to Riss-Würm, is shown to coincide fairly closely with the sequences and their geological correlations in both Germany and France.

Early Sculpture from Iraq

SOME unusual and important examples of early Sumerian and Babylonian sculpture from Iraq acquired for the British Museum (Bloomsbury) by the National Arts Collections Fund have been described and figured by Mr. Sidney Smith (*Brit. Mus. Quarterly*, 11, 3). The earliest in date is a grey granite vase, egg-shaped, with slightly flattened base. The present maximum height is 5¼ inches. Beginning ¼ inch above the base are three rows of round-topped leaf-like decoration, which often represents mountains; while the circumference at the centre is divided between two groups representing lions, each attacking a bull. The theme and carving show that this vase is closely connected with a limestone libation vase now in the Bagdad Museum found at Erech, stratum III. This fixes the date as the period of the polychrome pottery called Jemdat Nasr' ware, before the archaic Sumerian period. A steatite bowl, 7 inches in diameter, 4½ inches high, is carved on the outside in continuous low relief, which breaks up into separate groups, representing several acts, or different parts of a ritual, the connexion of water, bulls, snakes, vegetation, pointing to a rain-making ritual. Apart from its exceptional artistic merit, the bowl is of interest from the historical point of view. It is not later than the early part of the Agade period, about 2500 B.C., and it may be earlier. The appearance of Indian bulls on a local piece of work shows that close trade connexions led to an interchange of religious ideas. Secondly, the appearance of marked astral symbolism is important, because ordinarily Early Dynastic monuments show no such symbols, whereas they appear on the seals of early Indian type in some profusion, and in the same obscure connexion as on the vase. At present there is nothing improbable in the hypothesis that astral symbolism came into Sumer in the Early Dynastic period, through contact with the ancient civilization of India.

Movement within *Paramecium* Fragments

IN the usual protoplasmic streaming, or cyclosis, within *Paramecium*, the whole space of the endoplasm is occupied by a counter-clockwise movement, the cause of which has not yet been adequately interpreted. Teruhiko Hosoi narcotized *Paramecium* (*caudatum* type) by *iso*-propylalcohol and then cut the animals transversely into two parts at different levels (*J. Fac. Sci. Imp. Univ. Tokyo, Zoo.*, 4, 299; 1937). In each cut portion of whatever type cyclosis took place in the same direction as in the intact animal and without any marked change in the rate of flow after the injurious effect due to dissection had subsided. The author suggests that the motive force of the movement may lie in special substances attracted to the intersurface between the ectoplasm and the endoplasm and thus may lie along the entire course of the cyclosis.

Antarctic Polychaetes

A STUDY of the polychaetes collected by the *Belgica* Antarctic Expedition of 1897–99 was begun by M. Pruvot many years ago, and by 1905 he had made numerous notes and drawings on the Aphroditidae. His death unfortunately took place before the work was ready for publication, and thus it happens that it is only now that Prof. P. Fauvel has ably edited and brought together those observations and drawings of Pruvot's, which are still of interest to-day ("Résultats du Voyage de la Belgica en 1897–99". Rapports scientifiques: Zoologie. Polychètes par Pierre Fauvel. Anvers, 1936). Prof. Fauvel has in addition completed a description of the collection. At the time when it was originally made, more than a dozen species were new to science, but during the years that have elapsed since then most of them have been described in the reports of other expeditions, leaving three only to be here recorded as new. The *Belgica* records are, however, valuable in that they give additional evidence concerning geographical distribution, and from that point of view especially this report will be welcomed. Emphasis is placed on the cosmopolitan distribution of certain species, at one time considered bipolar, but actually found in temperate and tropical seas of both hemispheres. It is also remarked that temperature seems to have much more influence on polychaetes than does pressure.

Rust Fungi of the Philippines

MANY new species are described in the second paper, by J. C. Arthur and George B. Cummins, on Philippine rust fungi in the Clemens collection, made in 1923–26 (*Philippine J. Sci.*, **61**, No. 4, 463–488; Dec. 1936). *Crossopsora fici*, as its specific name suggests, attacks *Ficus variegatus*; *Pucciniosira clemensiæ* parasitizes a species of *Berberis*; *Gerwasia asciculata* occurs on *Rubus* sp., whilst *Uredo derridicola* forms pustules upon the insecticidal *Derris* plant. *Sphærophragmidium irregulare*, *Ravenelia lævioides*, *Spumula clemensiæ*, many species of the genus *Uredo*, *Endophyllum emasculatum*, *Puccinia plectranthella*, *P. hemigraphidis*, *Aecidium manilense* and *A. dapsile* add to the imposing list of species new to science. Latin diagnoses make the descriptions of international value.

Tobacco Mosaic Protein

Two papers recently available (*Proc. Amer. Phil. Soc.*, **77**, No. 4, April 22, 1937) summarize the fundamental work on virus proteins carried out at the Rockefeller Institute for Medical Research. Dr. W. M. Stanley gives evidence to justify the conclusion that a protein of unusually high molecular weight, obtained by him in crystalline form, is actually tobacco mosaic virus. The crystalline protein prepared from such different hosts as tomato and phlox, has the same chemical composition, isoelectric point, optical rotation and biological activity. Normal plant protein has a much lower molecular weight, and has other properties different from the virus protein. Crystals of the prepared material are needle-shaped, 0·02–0·03 mm. long, and give a regular crystalline pattern on X-ray analysis. Dr. Stanley's paper is highly informative, and supplies a succinct digest of the most recent work on this complex subject. Dr. Ralph W. G. Wyckoff describes "The Ultracentrifugal Study of Virus Proteins" in the same journal (pp. 455–462). He gives particulars of an air ultracentrifuge inspired by the original apparatus of Svedberg, with which he has demonstrated that the virus protein has a molecular weight of approximately 17,000,000. The apparatus can also be used to test whether the virus is one molecular species, or a family of related proteins, and can be employed to purify a virus extract, without chemical treatment, with its ultimate loss of strength. The delicacy of this method should make it possible to study less sturdy viruses than tobacco mosaic, and should open a new avenue of investigation.

Map of Ellsworth Trans-Antarctic Flight

THE material for a map of the Ellsworth trans-Antarctic flight of 1935 has been assembled by Mr. W. L. G. Joerg and Mr. O. M. Millar in the *Geographical Review* of July. The data consisted of sixty-six photographs taken during the flight and certain related photographs taken by Wilkins during his flight in 1928. Although much of the map is tentative, certain important conclusions emerge. Stefansson Strait of Wilkins disappears, and the peninsular character of Graham Land is re-established. Of equal interest is the narrow strip of shelf-ice lying on the south-western side of Graham Land and separating it from an enlarged Alexander Land or Island. This was crossed at an altitude of 3,050 metres and photographs were taken especially of the Alexander Land side. This strait was more thoroughly explored later by Mr. J. Rymill and found to be at least 200 miles long. The Graham Land side was found to be mainly eruptive rocks, and the Alexander Land side fossiliferous stratified rocks. The two sides, contrasted in the photographs, probably represent the meeting of the plateau and Andean structures of Antarctica. Farther along the track various mountain peaks were seen, notably the Sentinel Range (lat. 77° 15′ S., long. 88° W.) and another too far distant to photograph or even to place accurately, in about lat. 78°–80° S. and long. 85°–90° W. Nearer the Ross Sea the high ice plateau seems to be unbroken by range or nunatak. The maps are on varying scales and bring out these and other features clearly.

Effect of Obstacles on Sunshine Records

THE ideal to be aimed at in the placing of a recorder for the measurement of the duration of sunshine is a position where the sun is never obstructed when at a sufficient height above the horizon for a record to be obtained. For the standard instrument used in Great Britain—the Campbell-Stokes recorder—which focuses the sun's rays on a card and produces a burn when those rays are strong enough—it has been found that practically no record is obtained until the elevation of the sun exceeds 3°. The task of finding a position quite free from obstacles of greater elevation than 3° over those portions of the horizon, roughly from north-east to south-east, and from south-west to north-west, above which the sun passes during some part of the year at less than 3° elevation, is in many places an impossible one, consequently some information is desirable about the amount of loss resulting from obstruction, and this has been supplied by E. G. Bilham in "The Effects of Obstacles on Sunshine Records" (*Prof. Note* 76. (M.O. 336*p*.) London: H.M. Stationery Office. 4*d*. net.). The problem cannot be solved simply by calculating the length of time during which the sun is obstructed and comparing that with the total time during which it is above 3°, because there is a decided falling off in the frequency of recordable sunshine as the sun's elevation diminishes, due to haze, atmospheric absorption, varying cloud perspective, and other factors. If, however, the average percentage of the day's sunshine recorded when the sun's elevation is below various values in places free from obstruction is obtained, it is then possible to find the average percentage losses for obstruction of those values at places that have such obstructions. This is done up to 12° elevation, and it is shown that the percentage loss for a given altitude of obstruction is less in summer than in winter and less in the south of England than in Scotland. It is cheering to find that in general the percentage loss is much smaller than might have been expected; for example, in the summer half of the year, obstacles of 6° cause on an average little more than 1 per cent loss even if they extend laterally over the whole of the region occupied by the sun when its elevation is less than 6°.

Nature of Calomel Vapour

CONSIDERABLE interest has been taken in the nature of calomel vapour as deduced from vapour density measurements, that is, whether calomel is HgCl or Hg_2Cl_2, since this is connected with the problem of the molecular complexity of mercurous salts. Earlier measurements corresponded with HgCl. Odling, in 1864, observed that a piece of gold leaf is amalgamated in calomel vapour and he concluded that the vapour is dissociated to some extent at least

into Hg and $HgCl_2$, and this was confirmed by others. Smith and Menzies in 1910 showed that at 400° dissociation was complete in the sense of the equation $2HgCl = Hg + HgCl_2$. Since the mean molecular weight still corresponds with the formula HgCl, this is in agreement with previous work. H. B. Baker in 1900, however, had reported that when calomel was dried for three weeks in the dark with phosphorus pentoxide its vapour density at 400° corresponds with Hg_2Cl_2. F. T. Gucker, jun., and R. H. Munch (*J. Amer. Chem. Soc.*, **59**, 1275; 1937) have now reinvestigated the matter by measuring the absorption of the resonance line 2537 A. by calomel vapour. From 450° to 100° the results indicate complete dissociation of the vapour, in accordance with Smith and Menzies' results, in the case of undried calomel. The vapour of carefully dried calomel shows the presence of mercury only at temperatures from 400° to 250° but not below. Calomel sublimed in a vacuum at 200° and condensed on a target cooled with liquid air shows no trace of mercury, whilst the condensate from a mixture of mercury and excess of mercuric chloride, sublimed in the same way, showed mercury in the deposit. The vapour of carefully dried calomel also showed general absorption in the ultra-violet, which the undried calomel does not show. The results of vapour density measurements of carefully dried calomel at 375°–425°, however, corresponded with HgCl (or $Hg + HgCl_2$) and not with Hg_2Cl_2 as found by Baker.

Production of Artificial Radioactive Elements

INTERESTING work on the production of artificially radioactive elements by bombarding lithium and magnesium with α-rays of 8 cm. range from thorium-C′ is reported by A. Eckardt (*Ann. Phys.*, [v], **29**, 497; 1937). No radioactive elements could be detected by means of a Geiger counter when lithium was bombarded. Nuclei which might possibly have been formed are $^{10}_{4}Be$ and $^{9}_{5}B$ [$^{6}_{3}Li + ^{4}_{2}He \rightarrow ^{9}_{5}B + ^{1}_{0}n$; $^{7}_{3}Li + ^{4}_{2}He \rightarrow ^{10}_{4}Be + ^{1}_{1}H$]; but $^{10}_{4}Be$ is shown to be a stable nucleus. The stability of $^{9}_{5}B$ remains an open question, since its mass had not been determined when these experiments were carried out. Three possible radioactive nuclei, $^{27}_{14}Si$, $^{28}_{13}Al$ and $^{29}_{13}Al$, could be obtained from magnesium, of which the first two were detected. Their half-life periods are 7·6 min. and 2·2 min., respectively.

Adsorption of Gases and Vapours on Activated Charcoal

A CONTRIBUTION to our knowledge of adsorption and the formation of surface compounds is made in a note by R. Juza and R. Langheim (*Naturwiss.*, **25**, 522; 1937). The adsorption of gases and vapours on activated charcoal was investigated, particularly from the point of view of changes in the magnetic properties of the adsorbed substances. The paramagnetism of oxygen disappears when the gas is adsorbed at room temperature on activated charcoal. This probably indicates the formation of surface compounds between the charcoal and oxygen, which, like carbon monoxide and carbon dioxide, are not paramagnetic. In the case of the adsorption of benzene vapour, the paramagnetism of the system is less than that of the two substances taken separately and added together. Similar results are found for bromine and iodine. If the magnetism of the charcoal is assumed to be unaltered, there is a decrease in the diamagnetic susceptibility of benzene, whilst bromine and iodine become paramagnetic on adsorption. The paramagnetism in the case of bromine and iodine may indicate a splitting of the molecules into atoms under the action of surface forces, though another explanation is that the diamagnetism of the charcoal does not remain constant, but is decreased owing to the introduction of the adsorbed substance between the lattice planes of the graphite.

Astronomical Work at the Hamburg Observatory

IN the yearly report for 1936 by Dr. Schorr, director of the Hamburg Observatory at Bergedorf, it is stated that the 60-cm. refractor has been used for the photography of open star clusters, for spectrograms of Nova Lacertæ 1936 and for the spectra of variable stars. Vol. 2 of a *Durchmusterung* of stellar spectra is complete, and vol. 3 is in course of preparation. A very useful catalogue of proper motions (*Bergedorfer Eigenbewegungs-Lexikon*, 1 and 2) has been distributed. Two specimen plates taken with the Schmidt reflector and correcting lens are reproduced. These plates show the "North America" nebula in Cygnus and the Great Andromeda nebula. The diameter of the field is 8°, and the images on the edge of the field show, in the reproduction, no trace of elongation. An investigation has been made of the astrograph telescope and measuring machine (sources of error, corrections, methods of reduction, etc.) with the view of using this instrument in taking part in the re-observation by photography with wide-angle lenses, of the zones of the Astronomische Gesellschaft Catalogue, which was originally based on meridian observations centred around 1880. The work of deriving accurate star places by photography with lenses covering a field of 5° × 5° or greater was initiated, as is well known, by Dr. Schlesinger of the Yale Observatory.

Red Shifts and the Distribution of the Nebulæ

IN a paper under this title (*Mon. Not. Roy. Astro. Soc.*, **97**, May 7, 1937), Dr. Edwin Hubble considers the possible interpretation of red shifts as Doppler effects or otherwise. The subject has been treated in his recent work, "The Realm of the Nebulæ", and the present paper deals more fully with the problem. In the former work he points out that if red-shifts are simply velocity-shifts, the correction to magnitude is $4\Delta\lambda/\lambda$, but if they are not it is $3\Delta\lambda/\lambda$, and as the relation derived from observation is $2{\cdot}7\Delta\lambda/\lambda$, red-shifts are not velocity-shifts, unless some vital factor in the investigation had been ignored. The paper considers some of the criticisms of Eddington and McVittie. Eddington showed that in certain equations used by Hubble the possible effects of dispersion in the absolute magnitudes of nebulæ had been neglected. Nevertheless, Eddington himself, after investigating the effects of dispersion, finds that the necessary corrections are of no importance. Hubble is of opinion that the observational data, when weighted in favour of the theory of red-shifts being due to an expanding universe, "still fall short of expectations". McVittie's numerical errors in some previous calculations have been corrected; but, as Hubble points out, the revised figures do not affect the argument in the present paper. In a homogeneous, expanding universe, when corrections are applied for the dimming effects of red-shifts, a negative curvature would introduce an apparent thinning out of the nebular distribution. As observation shows an apparently increasing distribution density, a negative curvature can be adopted only if we discard the theory of homogeneity or expansion.

Road Design and Road Safety

THE causation of road accidents and the measures which can be devised for their prevention are subjects of close study all over the world, but despite all the efforts which have been made, the fact has to be faced that in Great Britain, during the past ten years, a daily average of nineteen persons have lost their lives on the roads. This gives emphasis to the importance of a paper published, with the discussion to which it gave rise, in the *Journal of the Institution of Civil Engineers* (December, 1936), entitled "Road Design and Road Safety", and presented by Mr. Frederick C. Cook, chief technical adviser to the Ministry of Transport.

A lengthy examination of the statistics of the problem was made. As was suggested in the discussion, it is to be regretted that the records and investigations are confined to fatal accidents, as the fuller information obtainable in the other and more numerous cases might be expected to shed more light on causation. From these figures, the outstanding facts are that in 1935 the number of persons killed on the roads in Great Britain was 6,477, of whom 3,079, or forty-eight per cent, were pedestrians, and that the total number of vehicles involved was 8,730, of which the largest number in any one class, 2,513, or twenty-nine per cent, refers to private cars. On referring the figures either to a basis of 100,000 vehicles licensed in each class or to each 100,000 estimated vehicle-miles, the author shows the private car to be the least responsible, public conveyances being most culpable on the first basis and motor-cycles on the second. Examination of the published official figures reveals that in view of the complexity of the problem and the number of factors involved, they are inadequate to lead to reliable conclusions. For example, it is indicated that fully half the fatal accidents occurred on straight roads ; yet here, where it might be that there were the elements of a clear case to decide as between road, car and driver, no analysis is given.

Going on to deal with the design of roads, the author considers and explains the influence of speed, desirable widths of carriage-ways, segregation of different classes of traffic and provision of dual ways, service roads, cycle tracks and footpaths, and their relation to traffic conditions. Such details of construction as the radius of curves, super-elevation, visibility, gradient and crossfall or camber are discussed and suitable minimum or maximum values recommended. In relation to the lay-out of road intersections, the author discusses the relative merits of a traffic signal installation, a roundabout, and a fly-over junction, and, of the last, illustrations were given both of a simple type and of one of the cloverleaf pattern.

With the view of obtaining a satisfactory road surface, testing of roads and materials and research are being continuously carried on, and it is hoped that asphaltic and bituminous coverings will be devised capable of maintaining non-skid properties for many years. Among the conclusions reached by the author, the most prominent are that the overwhelming majority of accidents are due to the personal element, that the main contributing cause is the simultaneous use of the road by motor vehicles, horse transport, pedal cyclists and pedestrians, and that, as the mechanically propelled vehicle is the most destructive agent, the most effective safeguard is the provision of special ways for its exclusive use.

Also appearing in the same volume is an abridged report of a paper—"A Study of the Underground Road Crossings of Paris"—contributed by M. Gaston Bardet, in which he gives particulars of the subways built when the fortification belt of 1814 was converted into a circular boulevard. Some unexpected problems were encountered in these, notably owing to the dazzling glare reflected by the glazed stoneware lining from ventilation apertures. In one subway the electric lighting is controlled by photo-electric cells, so that the internal intensity is synchronized with that outside. Consideration of the varying degrees of visibility to which the eye of the driver has to be adapted led to the arrangement of zones of graduated lighting in lengths of sixteen yards, and while incandescent lamps had been employed in some cases, the monochromatic character of the sodium light was found to make it more easy to regulate.

In Road Research Bulletin No. 1 (H.M. Stationery Office, 1936. 9*d*. net), G. Bird and W. J. O. Scott describe the construction and operation of a machine for accurately comparing the 'slipperiness' of surfaces. This has been developed at the Road Research Laboratory of the Department of Scientific and Industrial Research, and consists of a motor-cycle and side-car in which the wheel of the latter, by being set at an angle to the direction of travel, introduces a skid component into its motion relative to the road. Dynamometers are carried which record the transverse and vertical forces on the wheel, the ratio of these giving a 'sideway force co-efficient' analogous to 'co-efficient of friction', by which the non-skid properties of road surfaces can be compared. The technique of testing by means of the machine is explained and typical results quoted. The apparatus has been in use for a number of years, and having been brought to a sufficiently high degree of development is recommended for use by road engineers or surveyors to measure and compare for themselves the frictional properties of the road surfaces for which they are responsible.

Road Research Technical Paper No. 1, by the same authors (H.M. Stationery Office, 1936. 1*s*. 6*d*. net), the first of a series of studies in road friction, summarizes the results of a large number of measurements of resistance to skidding, made under varying climatic conditions and at different speeds on roads of several types, by means of the machine previously referred to. The main facts which emerge from these tests are : dry, clean road surfaces, free from loose material, give a high coefficient at all speeds and may be regarded as non-skid ; on wet surfaces the figure decreases as the speed increases and in most cases is subject to seasonal variation, being higher in winter than in summer ; in a dry-wet-dry cycle, the co-efficient decreases rapidly to a minimum, increases slowly to a fairly constant value until drying commences, when it begins to rise to the normal dry surface value. It is also shown that, notwithstanding greater first cost, improved results and ultimate economy can be obtained from close attention to technique in construction of road surfaces in the light of the information derived from these tests.

Agricultural Meteorology in India

THE progress of agricultural meteorology in India is outlined in the latest annual report of the Agricultural Meteorology Branch of the India Meteorological Department, which covers the third year of that branch, ending Aug. 21, 1935. In the Experimental Section, a diagram is shown in which is plotted for three different levels the march of temperature throughout the 24 hours in the stem of sugarcane and in the air at the same levels, the observations having been made in a small plot of sugarcane at Poona with the aid of a portable thermo-couple set specially designed for obtaining plant temperatures. This set was described in the previous year's report. It is seen that the sugarcane is cooler than the air during the day, but warmer at night. Further work on portable percolation gauges and evaporimeters is described in the same section.

Another interesting diagram relates to the microclimates of growing crops. Graphs are shown of the variation of dry bulb temperature and of vapour pressure at various heights up to 6 feet within the crops and in the open air during the hottest part of a typical fine afternoon in October, that is, in the clear season. The observed differences are greatest at the level of the ground, and in the case of the vapour pressure become small at a height of 6 feet. A large amount of experimental work was also done on the behaviour of various soils with respect to evaporation during the day and absorption during the night. It was found that the black cotton soils have the greatest diurnal variation of moisture content and the alluvial soils the least.

Radiation received a large share of attention, especially the nocturnal radiation from the surface of the earth and its relationship with the water content of the atmosphere. It is claimed that this study of the exchanges of radiation between the ground and various layers of the atmosphere explained why the temperature was found to decrease with height in the first few centimetres above the ground and then to increase.

In addition to these nocturnal studies, measurements were made with a pyrheliometer at Poona at fixed times on clear days, and every hour on representative days during each month, of the intensity of direct solar radiation and the distribution of energy in different parts of the spectrum ; a self-registering Moll solarigraph was also maintained in action during a large part of the year. Another solarigraph was set up at Shahjahanpur, and it is intended to install a third at Lyallpur, with the view of discussing eventually the seasonal variation of the total radiation of sun and sky in different parts of India.

A striking feature of the work in nearly all the branches of agricultural meteorology described in this report has been the amount carried out voluntarily by research students, some of whom were working for the M.Sc. degree.

Game Sanctuaries or National Parks

THE subject of the preservation of the wild fauna of the world, especially in those parts where for a variety of reasons there exists grave danger that interesting species may under the actions of man be exterminated, has been before the public on several occasions lately. The well-known national parks in the United States and Canada are often quoted as examples to be followed elsewhere. It is true that on a far smaller scale both national park and fauna (and flora) sanctuaries can be formed—even in the small island of Great Britain ; and evidence shows that steps are being taken to give effect to so desirable an object.

It appears to be a curious fact that in the British Empire such suggestions have met with little response until lately, either in Asia or Africa. That position is now also being rectified in some degree. In India the subject of fauna preserves has been ventilated for a number of years. In fact, fauna sanctuaries have been in existence since early in the present century.

The commencement was made in Assam, for the protection of rhinoceros, bison, buffalo and elephant ; though the latter has been under protective laws in British India for decades. About 1908–10 a fauna sanctuary was formed, under the auspices of Sir John Hewett, Lieutenant-Governor of the United Provinces, in the great sal forests at the foot of the Himalaya in these provinces. At the time there was a considerable divergence of opinion as to whether the sanctuary should be permanent or only for so many years, after which it would be opened to shooting and another area closed.

As a result of these early attempts and the more modern ideas attached to a national park which have been given ventilation in the Press of late years, in the spring of 1934 Lord Hailey, at the time Governor of the United Provinces, suggested that the Forest Department should make proposals for the creation of a game sanctuary or national park on the lines recommended by the International Conference of 1933, that is, a national park to be created by legislative authority. The account of this departure, and the formation of the Park to which the name of the Governor, Lord Hailey, was given, is detailed by E. A. Smythies ("The Hailey National Park". *Indian Forester*, 2. 467). The area selected for the park is in the famous and beautiful Patli Dun and the hill forests to the south of it in the Ramganga Valley, situated at the foot of and in the foothills of the Himalaya somewhat to the east of the River Ganges. The total area selected is about 125 square miles.

A Bill, the first of its type in India, was drafted. The United Provinces National Parks Act, 1935, was finally passed by the Legislative Council and

received the assent of both Governor and Governor-General. Its provisions are very wide. For example, "animal" is defined as "any mammal, reptile (excluding snakes, except python) or bird"; and it is an offence "to kill, injure, capture, or disturb any animal or to take or destroy any egg or nest of any bird". Permits have to be obtained by anyone wishing to enter or reside in the Park. Photography is permitted, but no flashlight apparatus may be taken in. Roads are projected in order to make this area freely accessible to the public.

Since the Patli Dun has long been famous for its tigers and leopards, it will be of interest to note any changes which may take place in their habits and attitude towards man, when the Park, which to date has seen little save the forest officer, timber contractor and hot weather shooting and fishing parties, becomes frequented by the holiday-maker and tourist.

Association of Special Libraries and Information Bureaux

Fourteenth Annual Conference at Cambridge

THE fourteenth Annual Conference of the Association of Special Libraries and Information Bureaux was held at Gonville and Caius College, Cambridge, on September 24–27. The programme of the Conference covered a wide field and merited a considerably larger attendance, although that was well up to the average of recent years. The address of the president-elect, Sir Harry Lindsay, on the Friday evening on "The Interrelation between Science, Agriculture and Industry" gave an excellent start to the Conference. Sir Harry stressed not merely the way in which the prosperity of agriculture and of industry were really connected, but also the importance of understanding the real differences between the objectives and methods of the agriculturist and the industrialist, with the view of developing a long-range policy which would eliminate conflict.

Pointing out that the manufacturer was better able than the agriculturist to adjust his output and methods quickly, so as either to benefit by increased demands or to shelter himself against reductions of demand, Sir Harry emphasized that the lesser susceptibility of agriculture to scientific control was due essentially to the fact that the agriculturist was dealing with Nature and the growth of living organisms, not with inorganic or dead matter. In addition, while the Great War gave a great impetus to scientific discovery and to the application of scientific method, it had also a disintegrating effect on the whole structure of industry and commerce, particularly in the destruction of credit. Although the ultimate effects of scientific discovery were beneficial, their immediate effects on business relations were disturbing. As an example, Sir Harry referred to the use made by the business man of modern means of obtaining knowledge of events to lay in or unload his stocks, and asserted his belief that the huge stocks of primary products which were a feature of post-War commerce had always existed, but in pre-War days were so spread that they were invisible and their effect unfelt. This throwing back of stocks on to the primary producer was another factor in the post-War years of disparity between the prices of agricultural produce and those of manufactured goods. Quality was another factor, and in competition between natural and synthetic products, the natural was usually the better although liable to fail in its resistance to standardization or to respond to increased demands. As regards foodstuffs the natural products still held their own. Despite the general cheapening of production and the higher standard of living, the cost of transport remained high and the question should be faced whether profit-making was the soundest principle on which to build our economic policy. Sir Harry considered that we were at present evolving a new technique of conscious control of economic life; long-range and not short-range solutions of our economic problems were required, and we were advancing to a new technique whereby instinct was supplanted by conscious constructive action.

A symposium on "Newspaper Indexing", at which Capt. A. C. Taylor presided, was opened by a paper by Miss Marie-Anne E. Walker of the *New York Times*, read by Dr. R. H. Hutton, which described the efforts made in this field in the United States, particularly the *New York Times Index* and the indexing project initiated under the New Deal Administration. Mr. J. J. Eaton of the *Yorkshire Post* approached the subject from a different angle, giving an impressive picture of the range of information which a newspaper library was expected to supply whether for the internal staff of the paper or for its readers. In describing the actual indexing system used, Mr. Eaton referred to the possibilities of using micro-photography for this work which they were now exploring. The discussion and papers alike stressed the value of the newspaper as a source of contemporary history, and the increasing reference to scientific matters in the Press renders the subject of some immediate interest to scientific workers. Already it not infrequently happens that not merely the earliest but sometimes the only report of a scientific meeting or discussion appears in the daily Press.

At the next session of the Conference, Dr. S. P. Turin presented a paper on "Scientific and Technical Research in Soviet Russia", in which he emphasized the need for establishing some system of regular research work on Russian subjects if much valuable work was not to be lost. Already constant watch on publications was required to obtain really exhaustive knowledge of any subject of research. Dr. Turin gave a list of various research institutes as well as an outline of the work of three associated with the oldest universities, and some details of science and special libraries in Russia. His plea for a central research body was accompanied by reference to conditions which must be fulfilled in establishing regular contact with Russian institutions. In the first place it was necessary to emphasize our *bona fide* interest in scientific and technical research and to show that we did not desire to utilize Soviet inven

tions and patents to undermine the Soviet system, but that our aim was international co-operation in the interests of science. Intercourse must be established through the official channels, although direct intercourse with scientific workers on the spot was not excluded. In summarizing the discussion, Mr. J. G. Crowther, who presided, pointed out that it was clear that the present position was not entirely satisfactory and that real difficulties were being experienced in obtaining Russian scientific and technical publications.

A somewhat disappointing discussion on Saturday afternoon, over which Mr. W. MacNab presided, in the absence of Mr. T. F. Burton, dealt with the extent to which the present system of abstracting services covered scientific periodical literature. In his paper opening this discussion, Dr. S. C. Bradford, without adducing anything essentially new, called attention to the duplication which persisted under the present system and also to the danger of papers in an out-of-the-way language or in border-line sciences being missed. His conclusion that at present nearly two thirds of the worth-while scientific and technical papers are published only to be buried out of reach on the library shelves was obviously received with a good deal of scepticism by the Conference, and in spite of his insistence on the need for recognizing the essential unity of science and for much closer co-operation, the discussion led to no concrete proposals, nor was the question of organizing abstracting and indexing services by divisions of industry rather than by branches of science even raised.

The report presented to the annual meeting of the Association referred to an actual excess of expenditure over income during the year of £69, partly due to increased office expenditure and staff. While increased sales of publications are likely to rectify this position, a considerable increase in membership is required if the Association is to take up many projects which are in need of its attention. The report also refers to the progress of the Book List, the re-organization of the Panel of Expert Translators, the preparation for a new edition of the ASLIB Directory and the attention given to the indexing of early newspapers.

Lieut.-Colonel E. T. Crutchley's address on "The Public Relations Officer" on Saturday, which described the work of the Public Relations Officer in the Post Office, provoked an interesting discussion which largely centred on the success of this experiment in applied psychology by the Post Office in explaining its work to the public and recording its activities. The scheme was also highly suggestive for all those who are interested in the establishment of good relations between management and staff and customers in industrial organizations and commercial undertakings, or in large Government departments or public utility companies. Lieut.-Colonel Crutchley showed convincingly the opportunities for applied science which exist in this field.

An excellent paper on the principles and practice of technical translating was contributed by Dr. J. E. Holmstrom at a session on Sunday morning over which Mr. J. G. Pearce presided. Dr. Holmstrom laid considerable stress on the importance of lucidity and style in translation work and referred to the advantages of the dictaphone system in saving the time of translators. Dr. Holmstrom gave details of a number of useful dictionaries, on the merits of which Mr. H. H. Johnson of *Engineering* and other speakers in the discussion commented.

The most interesting session of the Conference was the second session on Sunday morning which, as Prof. R. S. Hutton pointed out in his introductory paper, was almost the first opportunity in Great Britain for librarians to review the development and prospects of micro-photography. The high capital cost of the mechanized equipment required was compensated by the large reduction in the running costs. The Draeger camera, the Folmer Graflex Corporation camera, the Recordak camera and the Saint Ret-Seidell camera all aimed at labour- and time-saving by mechanized control of exposure and advancing the film, by book-holding devices, etc., and for some of this apparatus an output of 5,000 exposures or 10,000 pages a day was claimed. The spools of films could be selected for either small quantities such as 36 exposures on a 5 ft. length or up to 1,000 ft. of film. The British Museum was already making micro-films for an American project to secure for subscribing American libraries copies of all English books published before 1550. It was estimated that there were 4,000 separate books to be copied and the cost of copying the 400,000 pages works out at about a farthing a page. Such films are available for reading in one of the projection or enlarging machines constructed for the purpose or can be used to obtain a photo-enlargement on paper. The use of micro-film for newspaper record purposes in the United States is already being extensively tried, and its large saving in space—estimated at more than 98 per cent of that required for the bound volumes—renders it highly attractive for other libraries. Dr. Hutton stressed the durability and non-inflammability of the film used and referred to its possibilities in regard to library union catalogues, bank cheques, census purposes, and the like as well as to others in conjunction with the Kolleritt system or photo-electric cells for selecting material required.

A paper by Mr. Watson Davis, which in the author's absence was read by Prof. Hutton, referred to developments in the use of micro-film in the United States, particularly those sponsored by the Documentation Division of Science Service to assist the publication of scientific papers and the Bibliofilm Service in the Library of the U.S. Department of Agriculture, which have now both been taken over by the American Documentation Institute. Mr. L. A. Sayce described his experience of micro-film work at Armstrong College, Newcastle-on-Tyne, and Mr. K. Stuart-Smith gave some account of work in this field for which Kodak Ltd. had been responsible. The discussion left a distinct impression on the mind that the library of the future may present an interesting resemblance to the library of the ancient world with its rolls of film in place of the rolls of manuscript.

At the concluding session on Sunday evening, when Mr. Will Spens, Master of Corpus Christi College, presided, Lieut.-Colonel C. Bridge described the work of the British Council, in which he insisted on the need for further private support if the work initiated was to be carried on effectively. Besides helping to establish lectureships and professorships at foreign universities and sending distinguished lecturers abroad, to build up libraries of British books abroad and to increase the circulation of British periodicals, the Council was now dealing with broadcasting and films. Colonel Bridge emphasized the endeavour of the Council to avoid counter propaganda in its work but rather to interpret the national point of view and to make known the full wealth of our civilization.

Recent Excavations in Roman Britain

COLONEL C. D. DREW, who is in charge of the excavation of the Roman house-site in Colliton Park, Dorchester (see NATURE, Aug. 21, p. 311), reports the interesting and unusual discovery of the leg of a Roman chair, made of Kimmeridge shale. It was found beneath the damaged floor of the heated room, of which the tessellated pavement, as previously reported, had collapsed. It was found that stonework supporting the floor had sunk where the filling of a pit had proved less compact than the surrounding chalk. The chair leg was found deep down in the filling of the pit, which was of considerable depth. It is richly carved with the head of an open-mouthed animal, and the foot terminates in a lion's claw. It is in an excellent state of preservation, but requires skilled treatment to prevent flaking, before it can be placed on exhibition in the Dorchester Museum. As articles of Roman furniture are of rare occurrence in Britain, the find is of considerable interest. Among other recent finds on this site are thirty bronze coins of the fourth century A.D. from a trial trench. The excavation committee has approached the County Council with the view of securing the preservation of the remains of this Roman house, and the matter is now under the consideration of a sub-committee of the Council.

A large and important collection of Roman relics has been discovered by the excavation section of the Thoroton Society of Nottingham on the corporation housing estate at Broxtowe in the old part of the city. According to report (*The Times*, Oct. 4), the finds include a grave containing bones and Roman coins, brooches, a silver spoon, rings, knives and dice of wood. Among the broken pottery is some highly glazed Samian ware of the first century, decorated with hares and hounds. A portion of the Roman road was uncovered and a quantity of oyster shells was found.

At Lincoln the demolition of an eighteenth century house abutting on the Newport Arch, the only remaining Roman arch in Britain which spans a public road, has brought to light evidence which reveals that the arch in its original form has a postern gate on either side. There is at present on the eastern side a postern gate which is used by foot passengers; but when the western side of the arch was laid bare by the recent work of demolition, the beginning of the spring of the second postern gate was disclosed. It corresponds with the gateway on the eastern side. The arch was scheduled as an ancient monument in 1924; and according to a report in *The Times* of October 4, it is hoped to modify the rebuilding scheme in such a manner as to allow for the restoration of the postern gate on the west side.

Excavation on what is supposed to be the site of the Roman town of Sulloniacæ at Brockley Hill, Middlesex, two miles north of Edgware on the east side of Watling Street, points to the possibility that it may have been originally a native town or *oppidum*, of which the population shifted after the conquest, attracted by the facilities for traffic offered by this trunk road. The investigation is being carried out by the London and Middlesex Archæological Society with the co-operation of the Stanmore and Edgware Historical Society under the direction of Mr. F. Cottrill, local secretary of the Society of Antiquaries (*The Times*, Oct. 1). The site lies at the east end of a gravel ridge, which rises to a height of five hundred feet.

The arrangement of banks and ridges at Brockley Hill recalls the site of Prae Wood at St. Albans, excavated by Dr. R. E. Mortimer Wheeler. A Belgic potsherd has been found in one of the ditches. A trench dug near the east side of the road gives a section of two depressions, twenty feet and nine feet wide respectively, in the natural clay. The filling of these depressions produced pottery of common late first and early second century types in considerable quantity, the common 'screw-neck' flagon predominating. Some sherds showed signs of over-firing, while some almost complete pots had been thrown away on account of flaws in manufacturing. This, with the evidence of masses of baked clay, brick and tile 'wasters', points to the existence here of a roadside industrial settlement for the making of bricks and pottery. Another trench revealed a Roman occupation layer of the first century, which had been partly removed by seventeenth century and early eighteenth century builders. Exploration farther away from the road produced no evidence of occupation beyond a small Belgic pit. No traces of a Roman building have been found. Evidently the kilns had been placed at the east end of the town to avoid the fumes which would be carried by the prevailing south-west wind.

University Events

GLASGOW.—Dr. Paul Bacsich has been appointed lecturer in embryology in the Department of Anatomy, and Dr. H. Ellis C. Wilson lecturer in pathological biochemistry at the Royal Hospital for Sick Children.

LONDON.—The following announcements have been made from University College: Prof. S. Sugden, formerly of Birbeck College, succeeds Prof. F. G. Donnan in the chair of chemistry; Prof. C. K. Ingold becomes director of the Chemistry Laboratories.

The Department of Geography has been moved to new, freshly equipped quarters in Foster Court (the block of buildings on the south side of the College, acquired in 1931).

The University has accepted the benefaction of the late Mrs. Florence Joy Weldon, of Oxford, who bequeathed her residuary estate upon trust for the foundation of a professorship of biometry for the higher statistical study of biological problems. The chair has been established at University College, the first holder being Prof. J. B. S. Haldane (see p. 612).

READING.—Dr. G. W. Scott Blair, of Rothamsted Experimental Station, has been appointed head of the Dairy Chemistry Department of the National Institute for Research in Dairying in succession to Captain J. Golding, who has retired.

ST. ANDREWS.—In connexion with the celebration of the quatercentenary of St. Mary's College on September 28 the honorary degree of LL.D. was conferred, among others, on the following: R. F. J. Fairlie, architect for the restoration of St. Salvator's Chapel, St. Andrews, and of the Scottish National Library; the Right Hon. Sir John Simon, Chancellor of the Exchequer; Prof. G. F. Stout, formerly professor of logic and metaphysics; and Sir Leonard Woolley, director of the Joint Expedition of the British Museum and the Museum of the University of Pennsylvania to Mesopotamia.

Science News a Century Ago

Government Experimental Distillery

THE issue of *The Times* of October 12, 1837, gave an account from Government papers of the Government Experimental Distillery, by which it was anticipated several millions a year would be added to the revenue and illicit distillation be suppressed. "The extensive premises, formerly the Hope Brewery, in Brown's-lane, Spitalfields," said *The Times*, "having recently been fitted up as an experimental distillery upon a large scale, under the superintendence of Dr. Birkbeck, by order of the Lords of the Treasury, for the purpose of testing the efficiency of Mr. Rudkin's apparatus for taking the excise on spirits in process of distillation, several preparatory distillings have taken place during the last fortnight, and yesterday the distillery was set at full work. The experiment so far has been in the highest degree satisfactory and in the opinion of Dr. Birkbeck and other scientific men sufficiently conclusive as to the utility of the invention."

The instruments previously in use were the saccharometer and thermometer, but "the utter inefficiency of the saccharometer and the thermometer for the purposes for which they are used has long been well known", and it has been declared that "there is at present no security for the collection of any portion of the revenue, except in the conscientiousness of the distillers. . . . Government, chiefly through the medium of the Royal Society, has long applied itself to remedy this evil. About 70 years ago Lord George Cavendish carried out a series of laborious experiments for this purpose, which led to no results, and upon his failure the matter was committed to Sir Joseph Banks ; but his labours were attended with no better success". According to Dr. Birkbeck, however, Mr. Rudkin has solved the great and important problem. "If his instrument eventually realises his professions . . . it will do away with all the inconveniences of the present system . . . as it registers the quantity, temperature and strength of every gallon of spirit as soon as produced, and before it comes under the control of the excise man and distiller."

Faraday's Diary

FARADAY'S Diary contained not only his notes on experiments but also his queries, references and reflections. Under the date October 14, 1837, he wrote :

"4048. Charge of clouds. How do they become electrified if there be no absolute charge ?

4049. No charge from breaking up sulphur or change of state.

4050. Nature of discharge through cracks in glass.

4051. Is Fischer's observation on variation of conductibility of platina sound or no, and if it is, what bearing will it have on thermo-electricity ? Bib. Univ., 1831, xlvi, 267.

4052. Matteucci—Expts. on Evaporation of water from soil as a source of Electricity. Bib. Univ., 1834, lvi, 328.

4053. *Thermo-electricity.* Is it possible Peltier's experiment (Bib. Univ., 1834, lvii, p. 181) can be true, i.e. that a thermo electric current produced such an effect elsewhere as to create an opposite current *greater* than the original ?

4054. Electricity in motion penetrates bodies. Statical Electy. does not, but is superficial. The reason of this is evident on the particle action theory without breaking in on a law or requiring a new one. Before the conduction took place and after the communication was completed, both insulating and conductive particles were polar—but one can equilibrate or discharge more than the other.

4055. *Induction*—Nobili has some general facts in very good relation to induction. Bib. Univ., 1835, lix, pp. 275."

Caverns in Brazil

THE October 1837 issue of the *Gentleman's Magazine* contains the following information : "Dr. Lund, the Danish traveller, now in Brazil, has discovered in the mountain chains between the Rio Francisco and the Rio das Velbas a great number of caverns ; among which Sappa Nova de Maquiné, in the Sierra de Maquiné, is one of the most remarkable. The mountain consists of clay slate, flinty slate and limestone of the transition period, in which last is the cavern described ; the total length of which from north to south is 1,440 feet, the height being from 30 to 40 feet, and the breadth from 50 to 60. It is separated by masses of stalactite into twelve divisions, of which only three were known before Dr. Lund explored them. The others, especially the innermost, were of such extraordinary beauty that his attendants fell on their knees and expressed the greatest astonishment.

"On the River Velbas, the banks of which the traveller afterwards traversed, the vegetation assumes a peculiar character. The inhabitants call the forests *catingas* (white forests). They form a thicket of thorny trees and bushes interwoven with parasitical plants of the same nature. The leaves fall in August, and from the beginning of September till the rainy season the *catingas* are as bare as European forests in winter. On this excursion Dr. Lund had an opportunity of examining nineteen caves, all of which confirmed his opinion of their geological formation. He has collected many remarkable particulars respecting the circumstances which must have taken place in a great inundation, as well as respecting its effects, and convinced himself by several indications, that its course in South America was from north to south."

German Scientific Association

"SOON after the meeting of the British Association at Liverpool," said the *Mechanics' Magazine* of October 14, 1837, "its German prototype the Society of 'Enquirers into Nature' (Naturforscher) held its fifteenth annual assembly at Prague. The object which seems to have attracted most attention this year was an apparatus for the production of powerful electric streams by means of steel magnets operating on a multiplying conductor. It was exhibited and explained by its inventor, M. von Ettingshausen, professor of physics in the High School at Vienna. This gentleman acknowledged that his apparatus bore some resemblance in principle to that invented for the same purpose by Mr. Clarke in London, and that it was by no means superior in power, but contended that the apparatus was the more simple and convenient of the two." It was agreed to hold the next meeting of the Society at Freiburg, in Baden, to afford an opportunity to Prof. Oken, the founder of the institution, "to be present at the operation of his own new apparatus, for the production of electric streams of science, from which he has been for ten years an unwilling absentee".

Societies and Academies

Paris

Academy of Sciences, August 2 (*C.R.*, 205, 301–344).

A. LACROIX : The reality of an eruption of the Soufrière of Saint-Vincent in 1718, from an observation made at Guadeloupe. In the records of the Royal Academy of Sciences for 1718 a letter has been found confirming an eruption at the island of Saint-Vincent, previously regarded as doubtful.

PAUL LANGEVIN : Sagnac's experiment. Criticisms of a recent note on this subject by A. Dufour and F. Prunier.

PIERRE LEJAY : The variations in the quantity of ozone contained in the atmosphere in the neighbourhood of Shanghai. An analysis of five years observations.

NIKOLA OBRECHKOFF : A theorem for the zeros of polynomials.

RAPHAËL SALEM : A generalization of Poisson's method of summation.

ROBERT CORDONNIER : The application of Verdet's law to solutions. The magnetic rotatory power of the ions.

JACQUES DUCLAUX and MIGUEL AMAT : Ultra-filters of carborundum. Carborundum powder has been separated by levitation into fractions of different sizes of grain, and from these, ultra-filters have been prepared capable of removing various colloidal suspensions, such as copper cobalticyanide, arsenic sulphide and ferric hydrate. The finest grain filters prepared fail to filter off Congo red.

MME. GERMAINE CHAUVENET and GABRIEL VALENSI : The velocity of oxidation of cobalt.

ANDRÉ MAMAN : Contribution to the study of the octanes. Ten isomeric octanes have been prepared and the temperatures determined at which carbon monoxide appears when the hydrocarbon mixed with oxygen is heated.

ANDRÉ DEBIERNE and LADISLAS GOLDSTEIN : New transformations produced at low temperatures (*frigadreactions*). It was shown in a previous note that certain gases, especially hydrogen and helium, in contact with carbon cooled in liquid nitrogen, gave rise to a large evolution of heat. In the experiments now described, the carbon has been replaced by other elements (beryllium, magnesium, aluminium, nickel, copper, sand) and the heat evolution noted. With beryllium and helium the evolution of heat is larger than with helium and carbon. Generally, the light elements give the most marked reaction. No radiations could be detected outside the apparatus, but it is suggested that the *frigadreactions* correspond to nuclear actions.

GEORGES PETIT : The mechanism of the attack by sulphuric acid on monomethylarsenic and dimethylarsenic acids.

RENÉ DUBRISAY and ALBERT SAINT-MAXEN : Researches on the basic lead acetates.

MAX MOUSSERON and ROBERT GRANGER : Some derivatives of the C_5 and C_6 1,2-cyclanediols.

LUCIEN DAUTREBANDE, PIERRE ANGENOT and EDMOND DUMOULIN : The study of esparto grass antiærosol filters. The protection of the antiærosol filters against moisture by a layer of dehydrating substance.

RAYMOND JACQUESSON : A type of crystalline texture observed in aluminium wires submitted to alternating torsion.

EDOUARD ROCH : The Visean of the Haut-Atlas to the east of Marrakech.

EMILE THELLIER : The disappearance of the permanent magnetization of baked earths by reheating in zero magnetic field.

MME. C. SOSA BOURDOUIL : Remarks on the composition of the pollen of some Ranunculaceæ and on their systematic position. The nitrogen percentage in pollen is different in different botanical groups. Thus in the *Aquilegia* type the nitrogen in the pollen varies between 6·6 and 7·2 per cent ; in the *Clematis* type, between 5·3 and 5·7 per cent ; the *Ranunculus* type, between 4·2 and 4·9 per cent.

MARC MURAT : The vegetation of the western Sahara in Mauritania.

G. LAVIER : The cytology of the Protists of the genus *Blastocystis*.

Cape Town

Royal Society of South Africa, July 21.

A. J. H. GOODWIN : Archæology of the Oakhurst Shelter, George. (6) Stratified deposits and contents. The stratified deposits, excluding grave infillings, etc., are here discussed. The deposits include Middle Stone Age, Smithfield B, Smithfield C, Normal Wilton and Developed Wilton. (7) Summary and conclusions.

H. ZWARENSTEIN : Gonadotropic activity of amphibian pituitary. Implantation of 8–20 mgm. of anterior pituitary tissue of *Xenopus lævis* in immature female mice caused opening of the vagina, enlargement of the ovaries with occasional hæmorrhagic follicles (blood spots) and a two- to four-fold increase in uterine weight. Control implants of frog's brain, muscle, liver, kidney, spleen and ovary gave negative results.

R. H. SMITHERS : Notes on the stranding of a school of *Pseudorca crassidens* at Berg River mouth in December, 1936.

F. SEBBA and W. PUGH : Gallium. (4) The phosphates and arsenates of gallium. Gallium orthophosphate has been prepared by neutralizing a solution of a gallium salt in presence of a phosphate. The gallium is completely precipitated as a gelatinous phosphate. A crystalline variety has been prepared under pressure. Both forms are anhydrous. Gallium otho-arsenate has been prepared in a similar way, and both gelatinous and crystalline forms have been obtained. The arsenate separates as the di-hydrate. A crystalline complex galli-arsenate has been prepared by using a large excess of arsenate in strongly alkaline solution under pressure.

August 18.

W. PUGH : Mercurous perchlorate as a volumetric reagent for chlorides and bromides. With bromphenol blue as absorption indicator, mercurous perchlorate gives an excellent colour change at the equivalent point. The results are accurate. It has the advantage over silver nitrate that it can be used in acid solutions.

P. W. LAIDLER : Pipes and smoking in South Africa : an account of the typology and distribution of pipes of clay, stone and bone in South Africa.

M. R. LEVYNS: The geographical distribution of plants in the western portion of the Little Karroo. The area discussed is bounded on the north by the Zwartberg and on the south by the Langeberg, and has an altitude a little under 2,000 feet. Numerous kopjes are dotted over the area. The flora consists largely of succulent plants and the vegetation as a whole is of a very open type. Four mountain ranges with altitudes in the neighbourhood of 5,000 feet occur as islands in the Karroo. Towards the summits of these isolated mountains the Cape flora gradually replaces the Karroo flora. This change may be correlated with an increase in rainfall.

J. C. MIDDLETON-SHAW: The teeth of South African fossil pigs (*Notochoerus Capensis* syn. *Meadowsi*) and their geological significance.

J. L. B. SMITH: An interesting post-larval stage of the "Galjoen".

Cracow

Polish Academy of Sciences and Letters, June 14.

TH. BANACHIEWICZ: The precision of an elliptical orbit determined from three observations.

S. KACZMARZ: The resolution of a system of linear equations by successive approximations.

K. KOZIEL: Some formulæ relating to the ratios n_1 and n_3 of the areas of triangles.

MLLE. L. STANKIEWICZ: The arithmetical operations in the calculation of inverses according to the method of Banachiewicz.

S. PIOTROWSKI: A method of determining the orbital elements of double stars with eclipses.

S. PIENKOWSKI: The fluorescence of octahydrofluorocyclene ($C_{48}H_{36}$).

S. MROZOWSKI: The influence of the presence of a gas and of the magnetic field on the degree of polarization of the fluorescence of iodine vapour.

A. JAGIELSKI: The dielectric polarization and viscosity of the chlornitrobenzenes in the liquid state.

MLLE. B. TWARDOWSKA: Contribution to the study of the fluorescence and adsorption of biacenaphthylidene ($C_{24}H_{16}$).

MLLE. Z. LEWKOWICZ: The influence of the wavelength of the exciting light on the relative yield of the fluorescence of benzene solutions of biacenaphthylidene ($C_{24}H_{16}$).

K. DZIEWONSKI and L. GIZLER: The synthesis of fluorocyclene ($C_{48}H_{28}$) and its transformations into other hydrocarbons.

W. BEDNARCZYK and L. GIZLER: The absorption of ultra-violet radiation by fluorocyclene and by hydrocarbon products of its transformations.

B. SKARZYNSKI: The absorption of ultra-violet radiation by ascorbic acid (vitamin C).

J. NOWAK: The age of the Magura grit in the region of Babia Góra.

MLLE. K. CISZEWSKA and M. KSIAZKIEWICZ: Comparison of the Wienerwald fleisch with that of the Carpathians.

F. ROGOZINSKI: (1) Contributions to the estimation of magnesium. (2) The gravimetric estimation of chlorophyll.

E. FRÖHLICH: Systematic studies on the Cochlearia of Poland and other congeneric European species.

L. KORZENIEWSKI: Biometric studies on the variation of the seeds of the Siberian cedar (*Pinus Cembra*).

W. JUSZCZYK: The distribution of the chromatophores in the skin of *Pelobates fuscus* and in that of flavistic specimens.

F. ROGOZINSKI: Carotenoids and chlorophyll in the digestion of the ruminant.

J. GALLERA: The development of the extra-neutral ectoderm in birds.

ST. MARKOWSKI: Evolutive cycle and biology of the nematode *Contracœcum aduncum*.

Rome

National Academy of the Lincei (*Atti*, **24**, 493–530; 1936).

F. SEVERI: Supplements to the general theory of correspondences between algebraic varieties (1).

G. BARBA: Definite polynomials (2). Classes of definite polynomials obtained from some which are fixed in advance.

G. ARRIGHI: Mechanics of floats with internal cyclic motions.

L. SONA: Dynamic actions of a translo-circulatory current which invests an obstacle consisting of two crossed laminæ.

P. CALOI: Hypocentral depths, with particular regard to the earthquakes of the Carnic Alps (June 8, 1934) and of Lake Constance (January 31, 1935).

G. LOLLI: Curves of alcoholæmia obtained by administering hydro-alcoholic drinks through a gastric and duodenal tube.

M. PITOTTI: Presence of a true subrenal capsule in *Selaci*.

S. RANZI: Endocrine glands, sexual maturity and gestation in *Selaci*.

Atti, **25**, 3–71; 1937.

F. SEVERI: Supplements to the general theory of correspondences between algebraic varieties (2).

E. ALMANSI: Fundamental principle of classical mechanics.

G. CHECCHIA-RISPOLI: Preliminary observations on the Cenozoic series of the Apulian Appenines.

G. BARBA: Definite polynomials (3). Interpretations, properties and supplements.

R. CACCIOPPOLI: Analytical character of the solutions of a class of problems of the calculus of variations.

M. HAIMOVICI: Surfaces which correspond through parallel tangent planes so as to conserve a Tchebycheff lattice.

E. MARTINELLI: Cauchy's formula for the analytical functions of two complex variables.

G. OBERTI: Wave propagation in imperfectly elastic systems.

G. PICCARDI: Molecular spectra and spectroscopic analysis (5). Detection of gadolinium.

C. SANDONNINI and N. BORGHELLO: Electrolysis of iodine monochloride in various solvents.

O. VERONA and G. BONAVENTURA: Influence exerted on the development of plants by the partial elimination of the reserves accompanying the embryo, and the probable presence in them of 'growth substances'.

E. CARANO: Memorial lecture on Pietro Romualdo Pirotta.

L. CARNERA: Memorial lecture on Friedrich Küstner.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, October 11

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. Phyllis Tookey Kerridge: "The Physiology of Hearing and Speech" (succeeding lectures on October 18, 25 and November 1)*.

Tuesday, October 12

UNIVERSITY OF LONDON (at the Institution of Electrical Engineers, Victoria Embankment, W.C.2), at 5.30.—Prof. Erwin Meyer: "Electro-Acoustics" (succeeding lectures on October 13, 15, 18 and 20)*.

ILLUMINATING ENGINEERING SOCIETY (at the Lighting Service Bureau, 2 Savoy Hill, W.C.2), at 5.30.—Dr. S. English: Presidential Address.

Thursday, October 14

INSTITUTE OF FUEL (at the Geological Society, Burlington House, W.1), at 2.30. Sir Philip Dawson: "Coal: the Next Step" (Presidential Address).

At 3.30.—Prof. Morris W. Travers: "The Study of Gases" (Melchett Lecture).

CHADWICK PUBLIC LECTURE (at Manson House, 26 Portland Place, W.1), at 5.30.—Prof. W. A. Osborne: "The Study of Nutrition".*

CENTRAL HALL, LONDON, S.W.1, October 13–5. General Discussion on Lubrication and Lubricants.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

CHIEF LECTURER IN ELECTRICAL ENGINEERING in the West Ham Municipal College, Romford Road, Stratford, E.15—The Principal (October 9).

TWO ASSISTANT KEEPERS on the Higher Technical Staff of the Science Museum, South Kensington, London, S.W.7—The Director (October 11).

CIVILIAN EDUCATION OFFICER (Grade III—engineering or physics) in the Royal Air Force Educational Service—The Air Ministry (E.S.1), Adastral House, Kingsway, London, W.C.2 (October 15).

TWO ASSISTANT TEACHERS OF MECHANICAL AND MARINE ENGINEERING in the Liverpool City Technical College—The Director of Education, 14 Sir Thomas Street, Liverpool, 1 (October 16).

HEAD OF THE CHEMISTRY DEPARTMENT of Swansea Technical College—The Director of Education, The Guildhall, Swansea (October 18).

ECONOMIST to the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (October 18).

HEAD OF THE CHEMISTRY DEPARTMENT of Northampton Polytechnic, St. John Street, London, E.C.1—The Principal (October 31).

LECTURER IN THERMO-CHEMISTRY in the Imperial College of Science, Prince Consort Road, South Kensington, S.W.7—The Secretary (November 8).

WATERWORKS ENGINEER for the Government of Nigeria—Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote *M*/5346).

HEAD OF CHEMISTRY AND APPLIED CHEMISTRY DEPARTMENT of Salford Royal Technical College—The Director of Education, Education Office, Chapel Street, Salford, 3.

ASSISTANT in the Intelligence Section of the Mineral Resources Department of the Imperial Institute, London, S.W.7—The Establishment Officer.

Official Publications Received

Great Britain and Ireland

Air Raid Precautions. Memorandum No. 5: Anti-Gas Training. (Issued by the Home Office, Air Raid Precautions Department.) Pp. 28. (London: H.M. Stationery Office.) 4*d*. net. [219

Report of a Joint Committee of the Chemical Society, the Faraday Society, and the Physical Society, on Symbols for Thermodynamical and Physico-Chemical Quantities and Conventions relating to their Use. Pp. 16. (London: Chemical Society.) 6*d*. [229

Technical Publications of the International Tin Research and Development Council. Series D, No. 3: Mechanical Properties of some Tin Bronzes. By Dr. H. Lepp. Pp. 11. (London: International Tin Research and Development Council.) Free. [239

Higher Education in East Africa: Report of the Commission appointed by the Secretary of State for the Colonies. (Colonial No. 142.) Pp. 136. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [239

Report of Operations and Proceedings under the Land Drainage Act, 1930, from the passing of that Act (1st August 1930) to 31st March 1937. Pp. iv+75. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [239

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended March 31, 1937. (M.O. 418). Pp. 56. (London: H.M. Stationery Office.) 1*s*. net. [239

Mines Department. Sixteenth Annual Report of the Secretary for Mines for the Year ended 31st December 1936, and the Twenty-ninth Annual Report of H.M. Chief Inspector of Mines for the same Period, with a Statistical Appendix to both Reports. Pp. 246. (London: H.M. Stationery Office.) 4*s*. net. [239

The Royal Scottish Society of Arts. Pp. 24. (Edinburgh: Royal Scottish Society of Arts.) [249

Post Office Green Papers. No. 36: Post Office (London) Railway. By Major W. G. Carter. Pp. 22+12 plates. (London: General Post Office.) [289

Other Countries

U.S. Department of Agriculture. Technical Bulletin No. 562: Some Moisture Relations of the Soils from the Erosion Experiment Stations. By L. B. Olmstead. Pp. 45. (Washington, D.C.: Government Printing Office.) 10 cents. [189

Commonwealth of Australia. Report of the Eighth Australian Cancer Conference held at Canberra, 13th–16th April 1937. Pp. 66. (Canberra: Commonwealth Government Printer.) [189

Annual Report of the Public Health Commissioner with the Government of India for 1935. Vol. 2. Pp. v+145. (Delhi: Manager of Publications.) 1.6 rupees; 2*s*. 6*d*. [189

Colony and Protectorate of Kenya: Forest Department. Annual Report for the Year ended 31st December 1936. Pp. 34. (Nairobi: Government Printer; London: Crown Agents for the Colonies.) 1*s*. [209

Kenya Colony and Protectorate: Department of Agriculture. Annual Report, 1936. Vol. 1. Pp. ii+184. (Nairobi: Government Printer; London: Crown Agents for the Colonies.) 2*s*. 6*d*. [209

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1936. Pp. ii+48. (Calcutta: Government of India Press.) [219

Southern Rhodesia: Geological Survey. Bulletin No. 32: The Geology of the Umtali Gold Belt. By A. E. Phaup. Pp. iv+186+15 plates. (Salisbury: Government Stationery Office.) 5*s*. [219

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia-Jaarverslag 1933. Pp. 27. Regenwaarnemingen in Nederlandsch-Indië. Zeven en vijftigste Jaargang 1935. Pp. 129. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [219

Transactions of the Geological Society of South Africa. Annexure to Vol. 39: The Pioneers in South African Geology and their Work. By A. W. Rogers. Pp. ii+139+8 plates. (Johannesburg: Geological Society of South Africa.) [219

Cooper Ornithological Club. Pacific Coast Avifauna, No. 25: The Natural History of Magpies. By Jean M. Linsdale. Pp. 234. (Berkeley, Calif.: Cooper Ornithological Club.) [219

Ministerio da Agricultura: Serviço Geologico e Mineralogico. Relatorio do Director de 1° de Janeiro a 31 de Julho 1933. Pp. 48. Boletim N. 84: Brachiopodos do Rio Parauary. Por Aristomenes Guimarães Duarte. Pp. 44+7 plates. Boletim N. 85: Prospecção magnetica no norte de Santa Catharina. Por Mark C. Malamphy, H. Capper A. De Souza, Irnack C. Do Amaral. Pp. 24+19 plates. Monographias, Vol. 11: O cretaceo de Sergipe. Pela Dra. Carlotta Joaquina Maury. Pp. 283. Album des estampas da Monographia N. 11. Pp. xxxv+28 plates. Publicação Avulsa 29: A politico do Ouro. Por Euzebio Paulo de Oliveira. Pp. 46. (Rio de Janeiro: Departamento Nacional da Producção Mineral.) [249

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 14: Items 3479–3565, April, May, June 1937. By Ernest A. Hodgson. Pp. 289–300. (Ottawa: King's Printer.) 25 cents. [249

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 18, No. 10 (Mathematics No. 25): Beiträge zur Geometrie der Kreise und Kugeln, 19. Von Sôzi Matumura. Pp. 229–240. (Taihoku: Taihoku Imperial University.) [249

India Meteorological Department. Scientific Notes, Vol. 7, No. 72: Normal Monthly Percentage Frequencies of Surface and Upper Winds up to 3 km. at Allahabad, Begumpet, Delhi, Sambalpur, Sandoway, Silchar and Victoria Point. Pp. 35–58. 12 annas; 1*s*. 3*d*. Scientific Notes, Vol. 7, No. 73: Daily Variations of Temperature and Pressure at Different Levels over Agra associated with passage of Western Disturbances. By S. P. Venkiteshwaran. Pp. 59–64+7 plates. 12 annas; 1*s*. 3*d*. (Delhi: Manager of Publications.) [279

Imperial Council of Agricultural Research, India. Scientific Monograph No. 11: Investigations on the Course and Distribution of the Nerves supplying Levator Anguli Scapuli and Rhomboideus Muscles and the Formation of the Phrenic Nerve in the Ox, with Observations on certain Anatomical Deviations. By H. N. Chelva Ayyangar. Pp. v+60+57 plates. (Delhi: Manager of Publications.) 4.10 rupees; 7*s*. 9*d*. [279

Annual Report on the Departments of Agriculture, Malaya, for the Year 1936. By O. T. Faulkner. Pp. iv+81. (Kuala Lumpur: Government Printer.) 1 dollar; 2*s*. 4*d*. [279