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## Science and Leadership in Industry

THE industrial position of the north-east coast of England has been built up on the four basic industries of coal mining, iron and steel production, shipbuilding and ship-repairing, and marine and general engineering. These four industries are among those most severely hit by the post-War depression. The report on the industrial survey of the area conducted in 1931 for the Board of Trade by Armstrong College, Newcastle-upon-Tyne, stated that the problem facing these industries was one of the scaling-down to meet a diminished demand which is likely to be permanent, but suggested that with enterprise the north-east coast should retain its pre-War proportion of the total output of the whole country.

The report recognised, on the other hand, that there was little prospect of increasing that proportion, but pointed out that this depended on the amount of initiative shown by the industrial leaders in the area. This emphasis on leadership was repeated throughout the report. Development, it insisted, depended largely on the adaptation of existing works to new needs and new conditions; the industrial future of the area depended in the main on its own business leaders. Wherever possible they must call in science to their aid. In agriculture, as in industry, what was needed was the willingness and ability to appreciate new ideas, to adopt new methods and to try out new enterprises.

Memoranda contributed to the report cited examples of recent failures of industry in this area, particularly chemical industry, to meet these needs and to provide a broad and enlightened scientific leadership backed by adequate research. As example, reference was made to the failure of the Newcastle Chamber of Commerce to grasp the opportunities afforded by such developments as

the manufacture of acetic acid and acetone, or the rayon industry, the synthesis of methyl alcohol and of liquid fuel from coal, all of which have since reached commercial production outside the area. The opinion was also given that the attitude of the shipbuilding industry towards research was not so favourable as it should be, and doubt was expressed as to whether without attention to research this industry would continue to lead the way. Prof. H. V. A. Briscoe insisted on the necessity for scientific invention and discovery to take the place that mechanical invention formerly held, and asserted that the chief hindrance to development lay in the fact that, in general, the directors and executive officials responsible for the policy and organisation of industry were unable to understand or appreciate scientific matters and methods, whether in technical manufacture or commercial operations. Because they did not really know or understand the basic scientific principles which underlie their operations, business men did not know enough either to seize the good or reject the bad when confronted with possible developments. He urged that business men should depute their task of consideration and decision in *technical* matters to scientific men who are also sound business men, though not necessarily having previous knowledge of the particular business.

The memorandum on science and industry which Prof. G. R. Clemo and Dr. J. T. Dunn have recently submitted to the District Commissioner for Depressed Areas at Newcastle-upon-Tyne, some points from which are described in an article on p. 323 of this issue of NATURE, indicates that unfortunately those warnings have as yet received little attention. The figures quoted in the memorandum relating to the employment of scientific

graduates in local industries indicate a most disappointing situation, even for a time of bad trade and general unemployment. Of 184 honours graduates in chemistry from Armstrong College, only a dozen secured industrial employment locally, although they were employed in large numbers elsewhere. In physics, only one out of thirty-nine honours graduates during the past five years obtained local employment in industry. Even in the applied sciences such as electrical engineering, only 20 per cent at most of the students are to be found holding local posts five years after graduating, in spite of the fact that about 85 per cent of them are attached to a works before entering college.

These figures in themselves are sufficient to suggest that neglect of scientific skill is one of the reasons for the industrial sickness on Tyneside, but other evidence also is quoted to show that the best possible scientific direction of industry is not exercised there to-day. Even if it be admitted that a committee of men of science may over-estimate the importance of employing scientific workers, the instances cited of missed opportunities in regard to new developments in coal products as well as the continued absence of a definite centre for shipbuilding research and the neglect of valuable by-products of the fishing industry, show that lack of foresight and not the general absence of jobs is the real reason for the non-employment in the area of graduates in science.

The singularly slight use which Tyneside is making of its fine centre of scientific education in Armstrong College is not due to the recruitment of scientific staff from other universities, for no case of any such appointment was discovered in the inquiry. Moreover, there is evidence of a similar neglect of technical education, and the absence in the district of any chair founded or laboratory built and endowed by industrialists, as are to be found at Manchester or Liverpool, for example, is further significant confirmation of the inadequate recognition of the importance of industrial development.

In contrast with the present position, it must be remembered that the alkali industry of the north-east coast of England was founded and carried on by men who made the best use of the science of their time; for long it was a source of prosperity to the district. The Newcastle Chemical Society was founded in 1868 and was a highly flourishing society when its membership in 1883 became the nucleus of the Newcastle

Section of the present Society of Chemical Industry. Moreover, the whole area, with its natural advantages in the situation of coalfields and iron-works, enjoyed its full share of prosperity during the first part of the industrial revolution.

The indictment brought forward in Prof. Clemons and Dr. Dunn's memorandum is thus supported by far too convincing evidence to be lightly dismissed. While no one reason will account for the decline of the area, a great factor has been a narrow outlook which failed to recognise that industry is based on science, and that a policy which drains the profits and leaves insufficient resource for research and development is doomed ultimately to failure. The ease with which success has been gained in the past has induced the leaders of industry on Tyneside to rest too readily upon their laurels.

Lack of foresight as an outcome of prosperity experienced a generation or two ago is not confined to Tyneside. Similar charges have been brought against the textile industry in Lancashire, particularly of the neglect of technical training and the use made of juvenile labour. In his jubilee lecture to the Society of Chemical Industry this year, Mr. C. J. T. Cronshaw showed how the decline of the early dyestuffs industry in Great Britain could be traced to an exactly similar lack of foresight on the part of its leaders, and under modern conditions industry more and more demands this quality of foresight. As successive reports of the Department of Scientific and Industrial Research have emphasised, industry in Great Britain can only meet the fierce competition to which it is now exposed by a determined and persistent effort to apply the results of research and scientific discovery both to the cheapening and improvement of existing products and the development of new ones, as well as to the exploration of the natural resources of the country, combined with close attention to the question of technical training, efficient organisation and management. The nation cannot, in fact, afford to allow industry to be retarded by leaders who have lost the capacity of foresight and leadership, and whether in the depressed areas or elsewhere means must be found of rectifying the position.

So far as defective industrial leadership has contributed to the present position on Tyneside, it is probably not too late for a number of remedial measures to be applied. The various memoranda presented to the District Commissioner indicate several directions in which investigations could profitably be initiated, and the District Commissioner

is unlikely to be without either the power or inclination to effect some of the obvious reforms. The great enterprise of Imperial Chemical Industries, Ltd., at Billingham, which has been carefully exempted from the Committee's argument, provides a stimulating example of what is possible when foresight and vigorous leadership are forthcoming.

On the general body of scientific and technical opinion in the area, however, as well as in the rest of the country, a special responsibility rests. Whatever reforms may be imposed by the District Commissioner from above, it is only as scientific workers complete the task of education initiated by this joint committee representing the local sections of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry, that we can expect to see the fullest and most scientific use made of the resources of the area either in materials or in man-power. From their ranks inevitably must be drawn many

of the future leaders. For many years they may be called upon to exercise those advisory functions suggested by Prof. Briscoe, and it is only as they insistently support the arguments advanced by Prof. Clemo and Dr. Dunn that we can hope to see the habits and prejudices of years broken down and replaced by more enlightened ones.

The action taken by this Joint Committee provides an example of the ways in which scientific workers can serve the needs not merely of the special areas but also of the whole country, an example fully as inspiring as that already provided in the industrial surveys carried out for the Board of Trade. Through this work their special knowledge no less than their civic zeal should find ample employment. In thus emphasising the practical directions in which developments are possible and the part which science has to play in industrial leadership and development, they will go far towards meeting the first need of these special areas in bringing them hope and creating work.

## The Basis of Modern Mathematical Analysis

### Inequalities

By G. H. Hardy, J. E. Littlewood and G. Pólya. Pp. xii+314. (Cambridge: At the University Press, 1934.) 16s. net.

**I**NEQUALITIES, as opposed to equalities, may be said to form the basis of modern mathematical analysis. The arithmetical definition of a limit is itself based upon the idea of inequality, and in the hands of the school founded by Weierstrass and his successors has removed from analysis the vagueness and mystery which were due to appeal to an indefinitely qualitative idea of continuity. A book on inequalities by three leading mathematical analysts is therefore an event in the realm of mathematical literature, the more so since no book on this subject has been published before.

The book was originally planned to form one of the Cambridge Tracts; but the authors soon found that a larger work would be necessary to fulfil the ideals which they had in view. These ideals demand a complete discussion of the important elementary inequalities by the most elementary methods appropriate to the case and an exhaustive enumeration of the cases where inequality degenerates into equality. Thus Cauchy's inequality

$$(\Sigma ab)^2 < \Sigma a^2 \Sigma b^2,$$

unless  $(a)$  and  $(b)$  are proportional, is a proposition of finite algebra (in the case of finite sums) and the proof should involve only the methods of that theory. Cauchy's inequality is itself a particular case of Hölder's inequality

$$\Sigma ab < (\Sigma a^k)^{1/k} (\Sigma b^{k'})^{1/k'},$$

where  $k > 1$ ,  $k' = k/(k-1)$ , unless  $(a^k)$ ,  $(b^{k'})$  are proportional. An inequality equivalent to Hölder's is

$$\Sigma a^\alpha b^\beta < (\Sigma a)^\alpha (\Sigma b)^\beta,$$

unless  $(a)$  and  $(b)$  are proportional, where  $\alpha, \beta$  are positive and  $\alpha + \beta = 1$ . When  $\alpha$  is rational this is also a theorem of finite algebra. When  $\alpha$  is irrational  $a^\alpha$  is not an algebraic function and a step outside algebra must be taken. If we define  $a^\alpha$  as  $\exp(\alpha \log a)$  the proof must necessarily involve the theory of the exponential and log arithmetic functions and this should be the only step outside algebra which is taken in the proof. On the other hand, if we define  $a^\alpha$  by

$$a^\alpha = \lim a_n^\alpha,$$

where  $(a_n)$  is a set of rational numbers whose limit is  $\alpha$ , then the proof should involve an appeal to this limiting property alone. Here, however, another difficulty arises. Assuming the inequality to have been proved for rational  $\alpha$ , in the passage

to the limit the sign  $<$  becomes  $\leq$ , whereas the sign should still be  $<$ , so that the proof is incomplete. The difficulty can be turned by putting  $\alpha = \gamma + \lambda$ ,  $\beta = \delta + \mu$  where  $\gamma$  and  $\delta$  are rational. Then, if  $\gamma + \delta = \varepsilon$ ,  $\lambda + \mu = \nu$ ,

$$\Sigma a^\alpha b^\beta = \Sigma (a^{\gamma/\varepsilon} b^{\delta/\varepsilon})^\varepsilon (a^{\lambda/\nu} b^{\mu/\nu})^\nu < (\Sigma a^{\gamma/\varepsilon} b^{\delta/\varepsilon})^\varepsilon (\Sigma a^{\lambda/\nu} b^{\mu/\nu})^\nu$$

But  $\Sigma a^{\gamma/\varepsilon} b^{\delta/\varepsilon} < (\Sigma a)^{\gamma/\varepsilon} (\Sigma b)^{\delta/\varepsilon}$ , and a similar inequality with  $\leq$  for the other sum. The theorem then follows by combination of these results. The same difficulty arises in the passage from a finite inequality to one involving infinite series or integrals. It is therefore important to frame proofs in such a manner as to avoid a passage to the limit whenever possible.

The first part of the book, Chapters ii-vi, aims at a systematic treatment of inequalities centred round the three fundamental inequalities: (1) The theorem of the arithmetic and geometric means; (2) Hölder's inequality; (3) Minkowski's inequality, namely,

$$\mathfrak{M}_n(a) + \mathfrak{M}_n(b) > \mathfrak{M}_n(a + b), \quad n > 1,$$

where the symbols refer to the weighted mean

$$\mathfrak{M}_n(a) = \left( \frac{\Sigma p a^n}{\Sigma p} \right)^{\frac{1}{n}}$$

The apparently exceptional position of the geometric mean is elucidated by theorem 3, where the geometric mean is shown to be

$$\lim_{n \rightarrow 0} \mathfrak{M}_n(a).$$

In Chapter iii the idea of means formed with an arbitrary function  $\varphi(x)$  is introduced by the definition:

$$\mathfrak{M}_\varphi(a) = \varphi^{-1}(\Sigma q \varphi(a)), \quad \Sigma q = 1,$$

the arithmetic and geometric means corresponding respectively to the functions  $x^n$ ,  $\log x$ . The question of the comparability of two means formed with functions  $\varphi(x)$ ,  $\psi(x)$  leads to a discussion of the properties of convex functions and to generalisations of Hölder's and Minkowski's inequalities.

In Chapter v, theorems relating to finite sums are extended to infinite sums, the general conclusion being that such extensions are valid in so far as they retain significance. The corresponding extensions for integrals are carried out in Chapter vi. A simple example of the avoidance of a passage to the limit is furnished by the proof of Schwarz's inequality

$$(\int f g dx)^2 < \int f^2 dx \int g^2 dx,$$

which follows from the statement that the quadratic form

$$\int (\lambda f + \mu g)^2 dx = \lambda^2 \int f^2 dx + 2\lambda\mu \int f g dx + \mu^2 \int g^2 dx$$

is positive and therefore has a negative discriminant. Equality can only arise when constants  $\lambda$ ,  $\mu$ , not both zero, exist such that  $\lambda f + \mu g = 0$ . When the integrals are Lebesgue integrals, this means that  $\lambda f + \mu g = 0$  almost everywhere. By adopting Lebesgue-Stieltjes integrals (which include sums) the statement of dual theorems for sums and integrals can be avoided, and the theorems stated for integrals only.

The remaining four chapters constitute a series of essays on subjects suggested by the first six, and are intended as an introduction to certain fields of modern research. These chapters are full of interest and make accessible a large number of results scattered in mathematical periodicals.

Chapter viii deals with some properties of multilinear and bilinear forms, with interesting particular theorems on forms in [2, 2] Hilbert space. Incidentally, the  $y_j$  at the top of page 213 should be  $x_j$ .

Chapter ix contains a valuable discussion of Hilbert's inequality with its analogues and extensions. Hilbert's inequality is

$$\Sigma \Sigma \frac{a_m b_n}{m + n} < \frac{\pi}{\sin(\pi/p)} (\Sigma a_m^p)^{1/p} (\Sigma b_n^{p'})^{1/p'}$$

where  $p > 1$  and  $p' = p/(p - 1)$ . Much work had to be done before this final form was attained. The theorem is made to depend upon a more general result, due to the three authors, of which an elegant proof is given. The constant  $\pi \operatorname{cosec}(\pi/p)$  is the best possible, that is to say, it cannot be replaced by a smaller number.

Chapter x deals with rearrangements. The simplest problem of this kind is to find the arrangement of the sets  $(a)$ ,  $(b)$  which makes  $\Sigma ab$  greatest. The answer is, of course, when the two sets are monotonic in the same sense. The corresponding extensions to three or more sets, and the idea of rearrangements of functions of a continuous variable lead to extremely subtle and entertaining arguments.

The authors are to be congratulated on a masterly presentation of a subject which is as fascinating as it is useful to the mathematician. The applied mathematician will be interested to see theorems 216, 217, 218.

The printing is excellent, but it is a pity that bolder type was not used to distinguish the numbers of the theorems, which are in the same type as the paragraph numeration and exasperatingly difficult to find.

The book will form an indispensable addition to every mathematician's library.

L. M. M-T.

## Grasses

## The Gramineae: a Study of Cereal, Bamboo and Grass

By Dr. Agnes Arber. Pp. xvii+480. (Cambridge: At the University Press, 1934.) 30s. net.

GRASSES probably now constitute quite as large a family as the orchids, and no group of flowering plants includes so great a number of individuals as the Gramineæ. They are by far the most important from an economic point of view, whilst many botanists regard them as representing the peak of evolution among flowering plants. For grasses are found almost everywhere, occurring in nearly all phanerogamic plant-associations. They are, indeed, a *climax* group, not only as regards structure, but also as units of vegetation; and their origin and evolution are subjects for profound study.

Dr. Arber's work on the grasses approaches the subject from many points of view, any one of which would apparently supply material for an independent treatise as large as or larger than that under review; but in this work greater emphasis is laid on the morphological and anatomical aspects of grasses—subjects the author has studied for many years. It is a most interesting volume, not only to the expert, but to the lay reader as well; and it is not easy in a limited space to deal adequately with contents so varied and comprehensive.

Two chapters are devoted to cereals the seeds of which provide food for man. These include concise accounts of the more important, such as wheat, barley, rye, maize, oats, rice and sorghum, and the less important like teff, millet and ragi (korakan). Instead of being a seasonal product, as formerly, wheat is now garnered in some part of the world throughout the year, even at the equator, as in Kenya Colony. Although Dr. Arber says that the origin of the common millet, *Panicum miliaceum*, is unknown and quotes the classical work of De Candolle in suggesting the Egypt-Arabian region as its home, it is very probable that its wild prototype is represented by *Panicum callosum* from Abyssinia. The role of sorghums in tropical agriculture is briefly dealt with. The wealth of varieties brought to light during recent years, however, reveals their prime importance to the native races in Africa and India. There seems no doubt that the pearl millet is of polyphyletic origin, as the numerous races found in tropical Africa present very diverse forms in regard to habit and structure. Africa, as suggested, may have been the home of some of the cultivated

rices, as it is the home of most of the sorghums and pearl millets. Numerous wild species of rice occur in that continent, and in recent years another species of rice (*Oryza glaberrima*) has been found in cultivation in Upper Guinea.

The next chapter considers briefly pasture, sugar and scent. The quest for "pastures new" has been intimately connected with the migration of races of mankind, and the search for new grasses still goes on.

Four chapters are devoted to the bamboos, and it is interesting to read that in the Far East young bamboo sprouts, 3-5 inches in diameter, are like giant *Asparagus* and similarly used as a vegetable. Indeed, various kinds of bamboo are employed in an astonishing number of ways, from whet-stones to musical instruments, and even to drain-pipes (see p. 59). The chapter (vi) dealing with the interesting phenomenon of the periodic flowering of bamboos is very ably written, and many interesting features are brought into prominence. Some species only reach the sexual reproductive phase after a prolonged juvenile period, which may find expression in a definite term of years, but may be speeded up or retarded a little according to environment. Thus large forests of bamboos are periodically annihilated. Even plagues of rats are caused by this periodic flowering of the bamboo, for it is recorded (p. 91) that in Brazil these plagues synchronise with the fruiting and dying of a species called 'taquara', which abounds in the forests, each cane bearing about a peck of edible seeds resembling rice. The total quantity is enormous, and large areas are often covered to a depth of 5-6 in. with the fallen grain.

In her chapter on the relative age of woody and herbaceous plants, Dr. Arber makes no reference to a recent classification of the Dicotyledons (Hutchinson, "Families of Flowering Plants", vol. 1, 1926), in which it has been shown that most woody plants and herbs have arisen independently, and have been evolved side by side as parallelisms, the Magnoliaceæ and Ranunculaceæ being regarded as the most primitive, and examples of parallelism rather than close relationship. No such parallelism in regard to habit is to be found in Monocotyledons. Such monocotyledonous plants as are woody or sub-woody are much advanced in other ways, the yuccas, palms, agaves, etc., being familiar examples, and the more primitive Monocotyledons are all herbs. As the grasses are predominantly herbaceous, it seems most probable, therefore, that the woody members

which occur in the Bambuseæ are the most advanced of that tribe. For there are several herbaceous members at present assigned to this tribe with more primitive flower structure than that of some of the woody genera. These are *Guadua* and *Puellia*, with short creeping rhizomes, herbaceous culms, broad, flat, transversely veined leaves, and trimerous flowers (with three lodicules and six stamens).

In the final chapter of the series on the bamboos, a summary is given of the author's valuable researches on the so-called anomalous genera *Streptochaeta* and *Anomochloa*, which have been placed in various tribes by different authorities. Two separate tribes for these two genera have recently been constituted by C. E. Hubbard (Hutchinson, "Families of Flowering Plants", vol. 2, 1934). *Streptochaeta* is primitive in the possession of six stamens, a trifid style and a perianth almost equivalent to that of some Liliaceæ, and not resembling the familiar type of lodicule. *Anomochloa* is one of the most peculiar of all grass genera; in fact Dr. Arber is tempted to doubt whether it is really a member of the grass family at all. It much resembles certain Marantaceæ, whilst its floral structure is still imperfectly known, the lodicules being probably represented by a hairy ring round the stamens.

The constituent organs of the reproductive shoot have been the subject of much controversy. In her consideration of this portion of the grass plant, Dr. Arber first deals with the various types of inflorescence, leading on to its units, the spikelets. The structure of the latter often presents difficulties of interpretation owing to the reduction, modification or suppression of individual organs. The microtome technique employed by Dr. Arber and other workers has, however, in some cases assisted in solving these difficulties. The author describes all parts of the spikelet from a structural point of view, and follows it by an account of the method of flowering and seed production. Protogyny is considered to be rare in grasses, occurring in those which have no lodicules, such as pearl millet and meadow foxtail. She suggests that protogyny and lodicule suppression are interconnected, because the later emergence of the anthers is due to the difficulty of forcing the flowering scales apart, a function usually performed by the lodicules. In many genera the spikelets have been subjected to compression, causing reduction or suppression of some or all of the sexual organs, and even of some of the glumes, lemmas and paleas. A series of examples of sterilisation may be seen, commencing with *Hierochloë*, in which the lateral florets are male, and ending in *Phalaris*, in which they are reduced to rudimentary or very small lemmas. Even the

branches and branchlets of an inflorescence, as in *Pennisetum* and *Setaria*, may be entirely reduced to bristles.

Several chapters deal with the vegetative morphology of the grass plant from the germination of the seed to maturity.

Chapter xv discusses the distribution and dispersal of grasses, which are found in all parts of the world, from the humid tropical forests to the regions of perpetual snow. They are formidable competitors in the struggle for existence, and are usually capable of ousting other herbaceous plants. This is due mainly to their mode of growth and their adaptability. Only two flowering plants are known to penetrate the Antarctic, and it is interesting to note that one of these is a perennial grass, *Deschampsia antarctica*. Some genera show a remarkable range in altitudinal distribution; for example, very closely related species of *Festuca* occur from sea-level up to nearly 18,000 ft. The varied conditions under which they grow are probably not equalled by any other family. Besides the aquatic grasses, some typically terrestrial species will bear long periods of submersion in water, whilst the opposite extreme is to be found in those which are capable of withstanding extreme heat and drought, such as occur in desert regions, as, for example, *Spinifex paradoxus*, one of the dominant species in the Sturt Desert of Australia, and various species of *Aristida* in the Libyan Desert. Sand-binding grasses have been of great importance to man. Their use in preventing erosion in Great Britain was realised in very early days, for an Act of Parliament in the time of Queen Elizabeth decreed it illegal for the marram grass (*Ammophila arenaria*) of our sand-dunes to be eradicated.

The re-clothing of devastated areas by volcanic action is discussed by the author, who records that in the case of the island of Krakatau, doubt has been thrown on whether all plant-life was actually destroyed, and that probably some grasses in the form of their rhizomes or seeds may have survived, thus rendering the methods of their reintroduction open to question. The study of the methods of distribution of many grasses reveals some astonishing adaptations of both vegetative and reproductive organs for dispersal. Sometimes whole plants are carried considerable distances by wind or water. Besides those mentioned by Dr. Arber, it is interesting to note that at least one grass, *Stenotaphrum secundatum*, which grows along seashores in the tropics, probably owes its wide distribution to the fact that its runners and rhizomes are torn up and dispersed by the waves. In a number of cases the entire inflorescence, when ripe, disarticulates from the culm and is blown about by the wind, such as the well-known

*Spinifex squarrosus*, and some of the Australian 'umbrella-grasses', including species of *Digitaria* and *Chloris*. The spreading of seeds is effected in numerous ways; in many cases the parts of the spikelet bear hairs which at maturity form a spreading plume enabling the seed to be carried by the wind; in other cases, dispersal by wind agency is due to the diminutive size of the seed or to specially modified glumes and lemmas.

As the author states, unintentional conveyance by man and animals is responsible for the wide distribution of some grasses, especially those which have become serious pests in grazing land, like species of *Cenchrus* and *Tragus*, which are armed with barbed bristles.

The rather fancy title of "Pattern and Rhythm" lays stress on the homogeneity of the grass family as compared with others, and the numerous parallelisms which exist, not only between

different species, but also between species in different genera, and their resemblance to other families.

Because of recent works, Dr. Arber has limited her remarks on the systematic aspects of grasses to a taxonomic table of the genera referred to in the book (p. 410), whilst ecological notes are only incidental.

Dr. Arber is to be warmly congratulated on the production of a very attractive book, in which is collected a mass of information bringing together a summary of her numerous contributions on the family. There is a wealth of illustrations, a large proportion of which are drawings of microtome sections, the value of which would have been greatly enhanced, while they would have been more easily understood by the general reader had they been always accompanied by a text-figure of the plant itself.

## Ministering to Minds Diseased

### Psychology and Health

By Dr. H. Banister. Pp. viii + 256. (Cambridge: At the University Press, 1935.) 7s. 6d. net.

THE influence of the physical state of the body on the mental outlook has long been recognised—and a timely cathartic has often proved effective in dispelling a morbid and gloomy philosophy of life. But physical remedies are not always effective in combatting physical ills, as is witnessed by the case, treated by Dr. Banister, of a patient suffering from insomnia, who had, during seven years ordinary treatment, consumed gallons of soporific drugs without appreciable effect. Psychological treatment based on two visits of about an hour each brought about a complete cure.

It is possible that, as a class, medical men of the last generation tended to take what is termed a materialistic view of their science; it is more likely that, in medicine as in other branches of science, the supremacy of Dr. Stoffkraft was not long unchallenged. Indeed, many wise men and many wise physicians have long recognised, in health and in disease, the importance of the individual, and the controlling power of his mentality.

Surface psychology—which is anything but superficial—in its relation to the art of living is no new branch of knowledge. In unsystematised fashion, it has long been known. It may be studied daily in the lives of those around us by him who is equipped with the right sympathies and the appropriate background; it may be

followed in the records of the lives of those men, obscure or famous, who have seen life steadily and seen it whole; in the pithy sayings of Poor Richard, and of other more cultivated, but not necessarily wiser aphorists. Vauvenargues, La Rochefoucauld and Pascal can teach much to him who has the germ of an understanding mind. Think of Pascal's pregnant but bitter saying, "La curiosité n'est que la vanité. Le plus souvent on ne veut savoir que pour en parler"; with the saying in mind, listen to the next debate or discussion, take note, indeed, of one's own contribution, and recognise the truth which the aphorism enshrines.

The art of living is undoubtedly an art difficult to learn or to teach, but it has been taught, albeit unsystematically; it has been learnt; and the psychologist who will read his Boswell understandingly may learn much of the art as taught by his predecessors—especially if he will resist the temptation to estimate Johnson's intelligence quotient.

But we must return to the details of Dr. Banister's valuable treatise, which is concerned mainly with the treatment of the sick by psychological means and with the helping of those who, on a superficial view, may seem to be whole, but yet are suffering from such maladjustments to their environment as may be cured by an application of that most difficult art of taking thought—and of taking thought in a very special way.

After some preliminary discussion and definitions, chapters are devoted to the problem child,

infantile sexuality and allied matters. The troubles of the healthy and of the invalid are then discussed—succeeding sections deal with suggestion, hypnosis, the unconscious and dissociation, conversion hysteria, anxiety states and compulsions and obsessions. About thirty pages are devoted to a consideration of the views of leading Continental psychologists, and the book closes with three valuable chapters devoted to methods of treatment.

Dr. Banister's book should be considered as, primarily, a laboratory manual; it contains details of many cases and of modes of treatment which should prove of great value to medical students and to general practitioners—and not of least value to him who has already, in the light of his own reason, applied psychological knowledge to his own cases; he, indeed, will welcome a co-ordinated statement of psychological truth told in plain and simple language.

It is to be hoped that, in a second edition, case-details will bulk more largely than they do in this first edition. Despite the emphasis laid, and rightly laid, on the importance of the individual, it is a great encouragement to a young and untried student to find that instances exist which may help to explain some of his own difficulties.

A number of students of psychological method have been repelled by the obscure phraseology and jargon of the protagonists; not the least useful section of Dr. Banister's book is that which gives a succinct exposition of the theories of Freud, Janet, Jung and Adler.

Psychology has come to stay; and the book should certainly find a place on the shelves of the student of medicine—it will prove to be a very serviceable guide to those who will shortly be called to face the difficulties and decisions of a general medical practice.

A. F.

## Electrons

Electrons (+ and -), Protons, Photons, Neutrons and Cosmic Rays

By Prof. Robert Andrews Millikan. Pp. x+492. (Cambridge: At the University Press, 1935.) 15s. net.

THE appearance of a new edition of Prof. Millikan's well-known book "The Electron" will be welcomed by the many students of physics for whom the previous edition has become a standard text. The new edition differs from its predecessor both in its title and in the addition of six chapters dealing with recent advances in atomic physics, but the first ten chapters are essentially a reprint of the second edition of "The Electron" from which, at the request of the publishers, they differ only in minor details. It is a remarkable testimony to the previous presentation of the subject matter that new chapters can be added to the existing text with no apparent hiatus in the development of the book.

The first ten chapters contain, therefore, among other matters, an account of the circumstances which led to an accurate determination of the atomic charge. Beginning with the fundamental facts of electrolysis, the author proceeds to describe the first attempt at a direct determination of the atomic charge made by Townsend, involving the use of Stokes's formula to determine the size of small drops. He discusses the adoption and improvement of Townsend's method successively by J. J. Thomson and H. A. Wilson and finally

describes his own classic investigations on the value of the atomic charge and on the atomic nature of electricity.

Among other matters considered in detail in these early chapters are the Brownian movement in gases, the nature of radiant energy and the structure of the atom. Had changes in this part of the book been permitted, some reference to the Auger effect would no doubt have been made in the chapter on the mechanism of ionisation in gases, and also to the recent accurate determination of the atomic charge made in Prof. Regener's laboratory by E. Schopper, using a method based on that of Rutherford and Geiger and of Regener.

Among the six new chapters there is one on particles and waves, which treats in a simple but lucid manner particle-wave dualism in modern physics; and another on the spinning electron, with special reference to the work of Millikan and Bowen on the spectra of stripped atoms and to the new spectroscopic rules. There are admirably informative chapters dealing with fascinating topics such as the positron, the neutron, artificial transmutation and induced radioactivity.

Perhaps the least satisfactory section of the book is the chapter on the nature of the cosmic rays. In a work of this scope it would perhaps have been more useful to have given a general summary of contemporary investigations rather than to have indulged in a detailed analysis of particular investigations with which the author



has been associated, interesting and important though these are. The treatment of the subject matter appears to be directed towards establishing the hypothesis that the primary radiation is composed principally of photons, a view of its nature not generally accepted. Consequently, other investigations are treated somewhat summarily. For example, Clay's discovery of the latitude effect and Compton's organised world survey which confirmed it, receive but scanty treatment, whereas several pages are devoted to Prof. Millikan's recent surveys. No mention is made of the double-counter type of experiment introduced by Bothe and Kolhörster except in connexion with the east-west effect, of Regener's recent results with a Geiger counter in the stratosphere, or of the important observations of Kolhörster, Clay and Corlin on the penetration of the radiation into the earth and the sea. The inquiring student would be advised to supplement this chapter by reference to brief summaries of the subject such as those by Blackett and Corlin.

The book is throughout profusely illustrated, and particular mention must be made of the many beautiful expansion chamber photographs which illustrate the sections on modern atomic physics, while in spite of the somewhat dogmatic style, it is an extremely readable and lucid summary of a wide field of investigation.

The publication of a book by an authority of the standing of Prof. Millikan, whose own important researches cover a wide field, must be regarded as a notable event, and this book proves to be an important addition to the literature of atomic physics and a worthy successor to his classic work "The Electron". L. G. H. H.

The Science of Rubber ("Handbuch der Kautschukwissenschaft")

Edited by Prof. K. Memmler. Authorized English translation, edited by Dr. R. F. Dunbrook and Dr. V. N. Morris. Pp. xvi+770. (New York: Reinhold Publishing Corporation, 1934.) 15 dollars.

THE text of this publication consists of English translations of memoirs on the following scientific aspects, as distinct from the manufacturing technology, of rubber: botany, cultivation, preparation and collection (Zimmermann), chemistry (Pummerer and Koch), vulcanisation (Kindscher), chemical-analytical testing methods (Kindscher), physics (Hock), physical testing (Memmler and Schob) and microscopy of technical vulcanisates (Pohle). Edited in German by Memmler in 1930, it has now been translated and brought more up-to-date by the members of the Research Staff of the Firestone Tyre and Rubber Company under the general authorship of Dunbrook and Morris.

It is not possible in this short notice more than to touch on the general features of the publication,

which is a signal addition to English rubber literature. The subject matter of the text fills 675 pages. It is well illustrated and so adequately referenced as to make it encyclopædic in its scope. The authorship of each of its sections is authoritative. The translations are smooth. Most of the sections have been amplified by the American editors, but the botanical section could have been made more complete by the inclusion of recent work on variability and propagation.

The specialist, for it is to him that the book will have appeal, will find a use for the book no less for its bibliography, its author- and subject-indexes, than for the text itself. The indexes are models of completeness. There is no such thing as difficulty in finding one's way about the publication, and we doubt if even the specialist scientific worker will find any work of major importance unrecorded. The publication represents a piece of team work of unusual merit and something all too rare in the rubber industry. Its success, despite its high price, is assured. G. E. C.

#### Gardening in East Africa

A Practical Handbook by Members of the Kenya Horticultural Society and of the Kenya and Uganda Civil Services. Edited by A. J. Jex-Blake. Pp. xv+330+6 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 12s. 6d. net.

INNUMERABLE books on gardening have so ingrained it in our minds that a garden is a place in which plants from warmer climes are made to flourish in spite of our English winter, that the converse comes rather as a surprise. In this volume, the members of an English horticultural society describe their successes and failures in growing English garden-plants, with others, so near the equator as Kenya. It is a practical handbook that will be useful to gardeners in sub-tropical countries all the world round. The scientific aspects of the local horticulture are discussed in introductory chapters on climatology, soils, economic entomology and mycology, treated in a popular way, but containing a valuable body of knowledge for so young a colony as Kenya.

In a further edition more will doubtless be said about soil amœbæ, which play so important a role in most soils, and there will be need of more editorial co-ordination, for example, when the 'eel worm' has been described as a "parasitic worm" on p. 25, it should not be necessary to state on p. 310 that it is not a "vegetable", nor yet an "insect". The delightful plates are by the Misses M. Collyer and E. Napier. Lady Muriel Jex-Blake is responsible for two attractive chapters on flowering plants and shrubs and on climbing plants, while Mr. V. A. Beckley, senior agricultural chemist, has added chapters on the soil and on manuring and tillage. The foreword is by Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, who has not long returned from a friendly visit to South Africa, and is well aware of the difficulties of tropical horticulture, only to be overcome by the virtue of charity in the sharing of plants and experiences.

**Patterns of Culture**

By Ruth \*Benedict. Pp. xiii+291. (London: George Routledge and Sons, Ltd., 1935.) 10s. 6d. net.

DR. RUTH BENEDICT, in a stimulating and at times provocative book, has imported the theory of relativity into the study of social anthropology, which she, like some others, regards as the whole of anthropology. She argues that in the study of cultures, European spectacles and European standards must be abandoned, and the elements of any given culture under inspection evaluated exclusively in the terms of the culture to which they belong. How this works out in actual practice is demonstrated by a study of three strongly contrasted cultures, that of the Zuni Indians of New Mexico, of the natives of Dobu in Melanesia and the Kwakiutl of Vancouver Island. In the case of each, she shows the characteristic reaction produced by analogous circumstances in contrasting social conditions.

In demonstrating her theories, Dr. Benedict shows much originality and freshness of outlook. Her general position, however, in its stress on the relativity of cultural elements, does not in the long run get much beyond what the now much criticised 'evolutionary' anthropologist meant when he insisted upon sympathetic understanding in the study of the culture of backward peoples when construed in terms of their environments, even though he may have erred, according to the modern view, in regarding that environment as representing a stage in the development of culture.

**The Struggle for Existence**

By G. F. Gause. Pp. ix+163. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1934.) 13s. 6d.

THERE is no doubt as to the interest of biologists in all questions relating to populations and the struggle for existence. The author attacks these both as an expert mathematician and as a biologist, which his work shows to be a necessary combination. In animals, the processes in the struggle are much more complicated than in plants, where certain principles seem likely to be enunciated within a few years. Population growth requires to be studied together with its limiting factors, and this is further developed in chapters relating to the competitions both between species of yeasts and between species of *Paramecium*. Then follows a study of two species one of which devours the other, the chain here being Bacteria → *Paramecium* → *Didinium*. In Nature there can be no constancy of conditions; perpetual interferences, proved to be often due to immigrations, allowing no constancy of results.

Such investigations give ideas and stimulate that spirit of inquiry that rightly appeals so strongly to the younger biologists of to-day. The price (13s. 6d.) is too high for the ready sale that this book deserves; the American price is 3.00 dollars, so that this is only the fair exchange rate, whereas scientific books published in England are often priced at 50 per cent more than the exchange justifies in the States, a difference that kills their sale.

**Through my Telescope: Astronomy for All**

By W. T. Hay. Pp. xiii+128. (London: John Murray, 1935.) 3s. 6d. net.

THIS book, as its title suggests, is chiefly concerned with observational astronomy, although a sufficient background of astronomical facts is included to enable an intelligent interest to be taken in the objects observed. There is, in fact, a surprising amount of information compressed into its small space. The main theme, however, is the pleasure to be derived from, and the scientific value of, systematic observation of heavenly bodies with moderate instrumental equipment. The illustrations are from drawings by the author, and the plates give excellent ideas as to what one may expect to see in a medium-sized telescope—being far better for this purpose than photographs, which frequently give rise to disappointment at the telescope. The final chapter gives hints as to the use of telescopes, and the whole book should be an encouragement to many to follow the author's example in becoming regular astronomical observers.

**Wandlungen in den Grundlagen der Naturwissenschaft: Zwei Vorträge**

Von Werner Heisenberg. Pp. 45. (Leipzig: S. Hirzel, 1935.) n.p.

THE separate publication of these two lectures, which appeared in different periodicals in 1933 and 1934, directs the attention of a wider circle of readers to the views of one of the leading physicists of the day on natural knowledge. It is not without pride that Heisenberg reviews the field already conquered by modern physics. But in all humility he does not think that these conquests have brought us any nearer to the understanding of reality, because of the mathematical character adopted by natural philosophy. Pure speculation, on the other hand, can no longer claim attention if it ignores the formal results of scientific investigation. At present, the way to know Nature should be left for everyone to find individually, unless we wish to hope that the future will provide us with a single method satisfying all points of view.

T. G.

**British Industries and their Organization**

By Prof. G. C. Allen. Second edition. Pp. xi+338. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 10s. 6d. net.

IN the second edition of this most readable book (cf. NATURE, 133, 153; 1934) Prof. Allen extends his stocktaking of the major industries of Great Britain and their organisation to cover the years of the depression up to 1933. The statistical tables and bibliography have been brought up to date and the discussion of the far-reaching changes in economic policy during the last five years as well as of the course of Government action in the coal, the iron and steel and the cotton industries considerably enhance the value of the book to those who seek a broad view of these most important problems.

## Neglect of Scientific Direction in Industry

### Lessons of the Depressed Areas

IN January last a deputation representing the local sections of the Institute of Chemistry, the Chemical Society and the Society of Chemical Industry was received by Mr. C. Forbes Adams, the District Commissioner for Depressed Areas at Newcastle-upon-Tyne. Following on that meeting it was agreed to prepare memoranda on science and industry, coke, barium and other minerals, organic chemical developments and the ceramic industries, with the idea of directing attention to developments likely to lead to a permanent and progressive revival of employment in the area, and particularly to factors of fundamental importance from the technical point of view.

These memoranda have now been presented to the District Commissioner, and a further report on services to industry has yet to be completed. Together they provide a valuable commentary on the recently published first report of the Commissioner for the Special Areas\*. The latter report deals with the general position of the special areas and the measures required if the problem is not to be allowed to become insoluble. The outstanding need on which it insists is that of establishing conditions whereby industry will be attracted to, instead of repelled from, these areas. It is suggested that the initial effort should come from within by the creation of local markets to be supplied by local production. To support local initial effort, Government grants to influential and widely representative development councils will be required to give them every opportunity of planning reconstruction. While this is being effected, the areas must be relieved of all excess burdens, and the special measures now being applied continued and strengthened. Resident district commissioners are essential to watch over the interests of the areas on behalf of the Government, to further local co-operation and to secure co-ordination in all fields of activity. Local efforts and the assistance possible under the Special Areas Act require supplementing by wider Government measures designed to reduce unemployment generally.

The further proposals of the general report in regard to transference out of the special areas, raising the age of entry into industry to sixteen, contributory pensions and earlier retirement from industry, shorter working hours and holidays with pay are obviously palliatives, wise in themselves

but secondary to the question of finding work through the expansion of industry and creation of production. If, however, there is to be progressive industrial development in these areas, with full utilisation of their natural resources, scientific direction and research are essential. For this reason the adoption of the recommendations of the Joint Committee was urged on the District Commissioner for Durham and Tyneside.

The report on science and industry is signed by Dr. J. T. Dunn and Prof. G. R. Clemo, who, in support of the contention that the best possible scientific direction of industry is not exercised on Tyneside to-day, quote the case of a local firm which, after putting a new material on the market, found its behaviour in use was unsatisfactory. This could have been predicted if measurement of one of its fundamental physical properties had been made. The need for this was neither realised nor understood; nor, in fact, was there anyone on the staff competent to carry out the essential simple measurements. Lack of co-operation between actual business concerns in the area is another serious handicap to development, materials being bought from other areas which could as easily be, and actually are, produced in this area. As stressed in the Commissioner's report, the stimulation of local consumption of local production is a most important factor in the development of all the special areas.

Prof. Clemo and Dr. Dunn comment on the lack of progress in the area in recent times, apart from the great enterprise at Billingham, and this is reflected in the absence of local exhibits at the British Industries Fair. An even more significant pointer is found in the employment of scientific graduates in local industries. Of a total of 184 honours graduates in chemistry from Armstrong College in the fifteen years ending in 1934, only 12 (or 6.5 per cent) are known to have obtained industrial employment locally, 6 being with coal concerns, which number might have been greater had Armstrong College a Department of Fuel Technology. The situation is even worse in other pure sciences, such as physics, where only one out of 39 graduates during the last five years obtained industrial employment. In the applied sciences, although about 85 per cent of the students of electrical engineering are attached to works before entering college, only 20 per cent at most of these men are to be found holding posts locally five years

\* First Report of the Commissioner for the Special Areas (England and Wales). (Cmd. 4957.) Pp. viii+106. (London: H. M. Stationery Office, 1935.) 2s. net.

after graduating. Although definite figures are not available for other provincial universities, the opinion is expressed that elsewhere the position is very different.

Replies to inquiries whether chemists from other universities have obtained posts in this area during the last five years are incomplete, but with the exception of Billingham, no such appointment is known. Further, although the record of only 166 of the 184 honours graduates in chemistry is available, it is known that 20 occupy posts in universities or technical colleges, 77 in schools, and at least 37 occupy research or administrative posts in industry elsewhere; thus indicating that the right type of man is turned out in the area.

Prof. Clemo and Dr. Dunn accordingly urge that neglect of research is one reason why the area, in spite of its great natural advantages of coal and other valuable raw materials, combined with its favourable position, is in its present sorry plight. These advantages and its position relative to the forests of Norway and Sweden should have put the area in the forefront of the rayon and paper-making industries had the opportunity been seized some forty years ago.

The north of England did extremely well during the first part of the industrial revolution, and the alkali industry, founded and carried on by men who made the best use of the science of their time, was for long a source of prosperity to the district. The greatest factor in the subsequent decline has been the narrow outlook, which failed to see that industry is based on science, and that a policy which drains the profits and leaves insufficient reserve for research and development is doomed ultimately to failure.

This is more than ever true to-day, when Britain no longer holds her privileged position of a hundred years ago, and has to meet the competition of other nations who have improved their training and are applying intensively the results of research and scientific discovery to the improvement and cheapening of their products. As evidence that the importance of industrial development has been less fully recognised in this district than in other parts of Great Britain, reference is made to the absence of chairs or laboratories established and endowed by industrialists such as are to be found at Liverpool and Manchester. There has been no such full realisation in the area that new industries have sprung from pure research undertaken from non-utilitarian ends in university institutions.

It is concluded that general prosperity in the district will be impossible without an extensive application of scientific methods to those industries which the local raw materials and situation make possible. Eight years ago, for example, the

attention of the Chamber of Commerce and of the Tyneside Industrial Development Board was directed to several important new developments in coal products which were anticipated during the new decade. Several of these are now established processes—but elsewhere. Among the memoranda prepared under the guidance of the joint committee, that on coke directs attention to the desirability of an inquiry into the possibility of utilising the gas at present wasted at the coke ovens in the area, and in regard to the development of a coke for domestic purposes. The memorandum on barium stresses the need for an investigation on the possible uses of witterite. Another recommendation which indicates possibilities of development is that of the memorandum on the fishing industry, which calls for systematic investigation through the facilities at Armstrong College in regard to the working up of by-products from this industry, including the utilisation of fish liver oils. In particular, an investigation on the composition of herring oil is required.

Other memoranda on organic chemical developments suggest that a moulding industry could profitably be established in the district, although the manufacture of the actual resins and research in that should be left in the hands of the larger chemical firms of the country. Opportunities afforded to the local glass and ceramic industries are indicated, the seizing of which involves a strict scientific control of manufacturing processes, with some research work on both the improvement of existing products and the development of new lines, as well as adequate artistic guidance and the establishment of co-operation with local schools of art. Reference is also made to possibilities in the fire-proofing of timber and the preparation of sulphite pulp for paper making.

In the final section of their memorandum, Prof. Clemo and Dr. Dunn refer to the need for further endowment of Armstrong College, if it is to play its full part in restoring greatness to the area and particularly in research with a definite bearing on local industries. The technical colleges of the area cannot play their part in the development of local industry if they are hampered by lack of adequate equipment or staff. Their work is intimately related both to pure research and to the needs of industry. At one end of the scale they supply industry with young men well trained in the fundamental principles of their own branch of industry, who can therefore rapidly adjust themselves to the working conditions imposed by new discoveries; at the other end, they are teaching students to recognise and interpret their everyday work in the light of some guiding principles, with obvious gains to students and to industry.

## Wallace's Line and the Distribution of Mammals

THE very definiteness of 'Wallace's Line', which threads its way with precision, though without much apparent geographical reason, between Borneo and Celebes and between the almost contiguous islands of Bali and Lombok, and so marks the boundary between the Oriental and Australian zoogeographical regions, must have raised a doubt in the mind of many a zoologist; and sometimes the doubt seems to have been justified. In an introduction to the most important analysis which has been made in recent years of the facts of mammalian distribution bearing upon the authenticity of Wallace's boundary\*, Dr. W. K. Gregory cites two serious criticisms.

An examination of the fauna of the East Indian Archipelago led P. N. Van Kampen in 1909 to a very definite conclusion. "According to the researches of more recent times, among which should be mentioned especially those of Von Martens, Max Weber and the Sarasins, it becomes evident that such a sharp boundary as Wallace drew does not exist. Not only is there none where he drew it, but no such line exists anywhere in the Archipelago. Of course it is possible to draw such a line which apparently bounds the distribution of some single group; . . . But taking the fauna as a whole it is certain that no line may be drawn; but, rather, we may lay out a transition zone in which the fauna of India and that of Australia are mingled, and wherein from the west to the east the Australian components increase more and more in number; and on the other hand, the Indian tend to die out." Van Kampen regards all the transition region as being essentially linked with the eastern half of the Archipelago, that is with Wallace's "Australian" half, although he insists that even the boundaries of the transition region are not sharply defined.

More recently, W. D. Matthew (1915) proposed another solution which in effect obliterated Wallace's boundary as the Oriental-Australian divide. He created a new sub-region—Australo-Malaya—which included the islands east of the 'Line', "the debatable ground between the Oriental and the very distinct Australian region", although "the consensus of opinion classes it by preference with the Australian".

Now Henry C. Raven enters the debatable ground and, as the result of a very thorough study of the mammalian fauna, finds new support for the old 'Line'. He has some right to express an

opinion, for from 1912 until 1918 he collected mammals and other vertebrates in the Dutch East Indies for the United States National Museum, and from 1921 until 1923 he carried on similar collecting in Australia for the American Museum of Natural History. Finally, he has tabulated and mapped the distribution of all the known forms of mammals in the region—2,240 species and subspecies.

The broad fact which has weighed most with critics of 'Wallace's Line' is that many creatures have broken across it in an easterly direction. Raven, therefore, analyses the list of mammals which have transgressed the supposed boundary. His tables and maps are full of suggestive information, and it amounts to this: that the mammals which have crossed in greatest numbers are the bats, shrews, true rats and mice. True squirrels crossed from Borneo to Celebes; true pigs reached New Guinea; true deer (*Cervus*) spread from Java to Celebes, but were also carried about by natives. Indeed, all the transgressions cannot be attributed to natural distribution, for man transported some of the Viverridae, although *Paradoxurus* may have drifted over the boundary, and of other Carnivora, while one species of *Felis* reaches Sumba (not Sunba as in the text, p. 195), the dingo was man-borne. The lemur *Tarsius* and the macaques of Celebes complete the list, except for the greatest mammalian transgressor of all—man.

How does this list stand in comparison with the series of mammals which have found 'Wallace's Line' to be a real boundary? Of the East Indian forms which do not transgress the line, there are the hedgehogs (Erinaceidae) and tree-shrews (Tupaïidae) amongst Insectivora, the tree-shrews, with thirty-nine species, reaching Lombok and spreading along the west of the 'Line' to the Philippines; *Galeopithecus*; the Spalacidae; the squirrels (excluding *Sciurus*), with eighty-seven species widely distributed west of the 'Line' but none crossing over; porcupines, hares and rabbits; the pangolins; amongst the Ungulates, the chevrotains (*Tragulus*) with forty-three species in the Malayan region, the muntjac deer, tapirs and rhinoceroses have all had their wanderings checked at 'Wallace's Line'. So it is with most carnivora: the dogs (other than the dingo), the single species of bear, and the Mustelidae, of which eight genera occur in the Malayan region. Apart from the monkeys already mentioned, the Primates keep within the same limits, and they include thirty-six species of semnopithecus, fifteen species of

\* Wallace's Line and the Distribution of Indo-Australian Mammals. By Henry C. Raven. *Bull. Amer. Mus. Nat. Hist.*, 78, art. iv; 1935.

*Macacus*, eight species of gibbons and one highly variable species of orang—all of East Asiatic origin, and none transgressing the 'Line'.

Whatever may be said about the inefficiency of the supposed boundary, it is evident that it has acted as a real barrier to far more mammals and mammalian groups than it has allowed to pass; and, in Raven's words, "this seems consistent with the fact that 'Wallace's Line' for the most part marks the eastern boundary of the ancient continent, while the islands east of it have had only occasional contacts with it. The facts suggest that those numerous families which failed to cross Wallace's Line only reached it in relatively modern times after the barrier was fully established".

Much has been done in the region since Alfred Russel Wallace published his observations and deductions in the sixties and seventies of last century, and the general run of investigation is to suggest that by narrow and temporary land

bridges between deep seas, the islands of the Malay Archipelago made occasional contact with the old mainland of Cathaysia. So are explained the abundance of mammalian forms in the Malay Peninsula and Borneo, parts of the old mainland, and the relative scarcity of mammals in Celebes and the Philippine Islands, outliers of the continent. 'Wallace's Line' gains its significance and is a real boundary because it indicates the line of the continental shelf of the old mainland, and that marked the limit of distribution for most East Indian mammals. Van Kampen underestimated the significance of the 'Line', which Raven regards as being "well-established" by the distribution of mammals; this refers more especially, as Gregory points out, to the southern two-thirds of the 'Line', for the northern end, where it runs south of the Philippines, appears to mark a break of more recent formation and of less zoogeographical significance.

JAMES RITCHIE.

## Royal Society of Canada

### ANNUAL MEETING

THE Royal Society of Canada held its annual meeting on May 21-24 at McMaster University, Hamilton, Ontario. The presidential address by Prof. W. Lash Miller dealt with "Some Applications of the Methods of Physical Chemistry to the Study of Micro-organisms". The Flavelle Medal for 1934-35 was presented to Dr. F. T. Shutt, for his numerous contributions in the field of chemistry. The Lorne Pierce Medal was awarded to Dr. E. Montpetit, and the Tyrrell Medal to Brig.-General E. A. Cruikshank.

Prof. L. M. Gould, of Carleton College, Northfield, Minnesota, gave the annual public lecture, his subject being "Adventures in Antarctic Geology". Prof. Gould was a member of the recent Byrd expedition. His lecture was an outstanding humorous presentation of scientific facts.

In Section I (Literature française, Histoire, etc.) eighteen papers were presented, and seventeen in Section II (English Literature, History, etc.). Amongst a number of important contributions might be mentioned that of Dr. Lighthall on a newly discovered *Journal* of James and Andrew McGill. Besides supplementing greatly the hitherto scanty knowledge of James McGill, the founder of McGill University, this 522-folio-page work gives much information on the affairs of the North-West Fur Company from 1797 until 1814.

The contribution, "De l'influence de la révolu-

tion américaine dans la province de Québec" by Gustave Lanctot, and that by L. W. Howay on "Negro Immigration into Vancouver Island in 1850", served to emphasise the ever-present problem of the influence on Canada of political changes in the United States of America.

The feature of Section III (Mathematical, Chemical and Physical Sciences), which was held under the presidency of Prof. E. F. Burton, was a symposium on supra-conductivity. Prof. Burton in his presidential address gave a summary of the general phenomena of supra-conductivity. He was followed by F. G. A. Tarr, who spoke on the magnetic effects in supra-conductors, and announced that he finds the effective permeability to be influenced by the geometrical shape of the body. A. D. Misener gave results of experiments which indicated that the transition point for thin films of lead is a function of the thickness of the film. The results of experimental work done at the cryogenic laboratory at Toronto were summarised, and this was followed by three theoretical papers on the explanation of supra-conductivity, by C. Barnes, H. Grayson Smith and Prof. L. V. King. Prof. King's theory, founded on electric polarisation and space lattices, was an important contribution; the theoretical curves for the Wiedemann-Franz relation and the effect of a magnetic field on the transition temperature

are in satisfactory agreement with experimental results.

Among the hundred and twenty-nine papers presented to the section, space permits the mention of only a few. Prof. L. V. King presented a paper on the theory of acoustical resonators in which he succeeded in obtaining an exact solution for the case of a semi-infinite cylinder bounded by an infinite flange. The agreement with Rayleigh's approximation is excellent. Dr. L. Gilchrist and his collaborators presented two papers on the results of applied geophysical work and Dr. H. G. I. Watson spoke on an improved electrical method of using the point electrode in geophysical field work. A paper by Prof. J. Satterly and J. C. Strachan on the measurement of surface tension of water and mercury by means of stationary waves on a vertical jet was the subject of an interesting theoretical discussion as a result of the values obtained for mercury by this method. Dr. Otto Maass presented a paper in collaboration with W. H. Barnes and R. S. Brown giving the results of determinations of the specific heat of liquid  $D_2O$  from  $0^\circ$  to  $100^\circ$  C. Among the several papers by Dr. O. Maass and his associates, mention may be made of an interesting investigation on the dielectric constants of propylene and methyl ether for both the liquid and vapour forms from room temperature to  $10^\circ$  C. above their critical temperatures. A definite difference in dielectric constant of liquid and vapour has been found to persist above the critical temperature.

Dr. J. A. Gray and J. S. Marshall presented papers on the scattering of  $\beta$ -rays in which the loss of energy by a homogeneous beam scattered through an angle of approximately  $90^\circ$  is measured and the absorption in aluminium of homogeneous  $\beta$ -rays determined. Further results on the study of pleochroic haloes were presented by Dr. G. H. Henderson. Evidence for instabilities resembling eddies in the striated discharge from measurements made using a small Rayleigh disc was given in a paper by Dr. D. A. Keys. Dr. G. M. Shrum gave an account of a method of finding the vitamin A content of pilchard oil from the absorption spectrum. Dr. D. C. Rose read an interesting paper summarising the results of a series of continuous records of atmospheric potential gradient, taken at Ottawa, which show a relation between weather conditions and the deviations from the average type of diurnal variations. In a paper presented by J. O. Wilhelm, A. D. Misener and A. R. Clark, the results of viscosity measurements on the two forms of liquid helium were given. Helium I at  $2.3^\circ$  K. has a viscosity of 0.00027 c.g.s. units and helium II at  $2.2^\circ$  K. has a viscosity of 0.000033 c.g.s. units, which is not very different from that of helium gas. Several papers on

spectroscopy, particularly on the hyperfine structure of lines, were presented by Dr. Stanley Smith, A. B. McLay, M. F. Crawford and others.

An exceptionally interesting series of papers was presented in Section IV, and the following list of subjects discussed indicates their wide range of geological interest:

Physiology of northern British Columbia; the deformation of post-glacial lake terraces in Ontario; problems in stratigraphy in the complex series of southern Quebec; a late Cretaceous fauna of southern Alberta; a revision of the genus *Tetradium*; a revision of the genus *Calapoecia*; a discussion of *Archæocyathinae*; the differentiation and structural history of the Sudbury Nickel Irruptive; heavy accessory minerals in granites; igneous breccias; new types of pleochroic haloes and their causes; the composition of asbestos and related fibres; rock flour glacial 'White Silts' in southern British Columbia; fabric analysis in structural petrology; and geological deductions from deep focal earthquakes.

The meeting was brought to a fitting close by an excursion to examine the interesting geological features in the vicinity of Hamilton.

Prof. John Tait in his presidential address to Section V (Biological Sciences) spoke on "Some Structural Implications of the Respiratory Mechanism in Animals", and illustrated his viewpoint with examples from a very wide range of organisms. Eighty-six papers were presented in this section; Sir Frederick Banting, Prof. C. H. Best, Prof. E. M. Walker and their respective collaborators presented work on varied endocrinological and related subjects, which included respiratory metabolism and poisons; salt secretion; the site of formation of the phosphates of blood serum; the phosphoric esters of normal and malignant tissues; the biological effects of sericite and various other mine dusts; and the respiratory metabolism of the seal. Prof. J. B. Collip and his collaborators presented work on endocrine interrelations during pregnancy; the influence of prolonged administration of an anterior pituitary extract on the ketosis of experimental diabetes; the production of endometrial moles through operation on the rat uterus during the second part of pregnancy; the nature of the constitutional factor in chronic atrophic rhinitis; and a number of other papers on the effects of various hormone extracts. Dr. J. S. L. Browne and E. M. Venning showed the effects of various treatments on normal and ovariectomised women. Prof. H. Wasteneys and his colleagues presented papers on factors affecting the rate of protein breakdown and on the synthetic action of pancreatic lipase, together with reports on new biochemical techniques. Prof. D. T. Fraser and colleagues gave an interesting

group of papers on sera and toxins. Prof. P. Masson spoke on "La multiplicité probable des syncytium de Schwann".

Papers of a general zoological or botanical nature numbered thirty-one. Prof. Marie-Victorin, J. Rousseau and J. Brunel gave the results of systematic studies of the Quebec flora. Prof. R. B. Thomson presented a new interpretation of the segmental organisation of *Osmunda* and Prof. H. S. Jackson described variations in the short-cycle rusts; with their colleagues and students they presented a series of other papers on plant anatomy and mycology. Dr. J. H. Craigie gave an exhaustive account of the epidemiology of wheat stem rust. Dr. J. W. McArthur presented data on tomatoes which are of great significance for general theories of the inheritance of quantitative characters. Dr.

L. O. Gaiser showed the occurrence of different chromosome numbers in various wild populations of *Liatris punctata*. Prof. A. H. R. Buller reviewed our knowledge of the sclerotia of the higher fungi. Prof. G. H. Scarth and J. Levitt described a method of measuring water permeability of freed plant protoplasts and gave new data on the problem of cell permeability in relation to hardness.

A dinner in honour of Prof. Wilson Smith, professor of botany at McMaster University, who is retiring this year, and various field excursions were interesting features for this Section.

The social arrangements made by McMaster University and local residents, and the facilities for accommodation, exhibits and meetings provided by the splendid new buildings of the University were much appreciated.

## Obituary

Prof. B. L. Robinson

**F**LORISTIC botany suffered a heavy loss by the death on July 27 of Benjamin Lincoln Robinson. Born at Bloomington, Illinois, on November 8, 1864, he graduated A.B. at Harvard in 1887, and then studied under de Bary at Strassburg, where he took the Ph.D. in 1889. His early work was anatomical, especially on unusual stem-anatomy; his thesis was on the stem-anatomy of *Phytocrene macrophylla*.

Returning to Harvard, Robinson became assistant in the Gray Herbarium under Sereno Watson, and on Watson's death in 1892 was appointed curator. The development of the Herbarium and the continuation of the taxonomic researches on American botany begun by Gray and continued by Watson have been Robinson's life-work. He found the Herbarium poorly housed, inadequately equipped, with a meagre endowment, and no definite status in the University. By the aid of generous donors he was able, during the years 1909-15, gradually to replace the little old building by an imposing modern structure which has been described as the safest and most conveniently arranged and best equipped herbarium building in the world. The endowment in 1899, by Mrs. Gray, of an Asa Gray professorship of systematic botany, of which Robinson was the first incumbent, added instruction to the functions of the Herbarium.

Two important pieces of work demanded attention when Robinson became curator—the completion of Gray's "Synoptical Flora of North America", and a much needed revision of Gray's "Manual of Botany". The former, with the aid of several experienced botanists, was completed in 1895-97, and the latter in conjunction with M. L. Fernald in 1908.

The results of Robinson's work and that of his assistants, on the floras of North America, Mexico

and tropical South America, are embodied in a long series of papers in the *Proceedings of the American Academy of Arts and Sciences* and other periodicals. The substantial volumes of the reprints collected in the convenient form of "Contributions from the Gray Herbarium" are a monument to their industry. Robinson was specially fond of the Compositæ, and his "Revision of the genus *Brickellia*" was the first of the larger "Memoirs of the Gray Herbarium" begun in 1907.

Robinson's interest in local and regional botany found expression in the New England Botanical Club started in Boston in 1895, and for thirty years after its inception in 1899 he edited its journal, *Rhodora*. The Club collection lodged in the Gray Herbarium numbers more than 150,000 sheets.

British botanists showed their appreciation of Robinson's work by electing him to the foreign membership of the Linnean Society of London in 1922. His colleagues and friends at home and abroad will regret the passing of an eminently sane critical botanist and a courteous and kindly gentleman.

A. B. RENDLE.

WE regret to announce the following deaths:

Lieut.-Colonel H. W. Acton, C.I.E., formerly director of the School of Tropical Medicine, Calcutta, on August 23, aged fifty-two years.

Prof. Henry Briggs, O.B.E., Hood professor of mining in the University of Edinburgh since 1924, and professor of mining in Heriot-Watt College since 1919, on August 24, aged fifty-two years.

Prof. E. Jeanselme, emeritus professor in the faculty of medicine in the University of Paris, known for his work on syphilis, leprosy, and the history of medicine, aged seventy-seven years.



## News and Views

### Protection during Air Raids

THE recent air exercises at Portsmouth have shown once more that in some states of the weather it is impossible to prevent a hostile air fleet from launching an attack upon a city. It is essential, therefore, that we should do all we can to minimise the effects of air raids, if unfortunately it should be found impossible to prevent wars. The Government is preparing a series of six handbooks dealing with different aspects of the problem, and the first of these has recently been issued (*Air Raid Precautions, Handbook No. 2. Anti-Gas Precautions and First Aid for Air Raid Casualties*. Pp. 110. London: H.M. Stationery Office, 1935. 6d.). Mr. C. B. O. Mohr, 147 Milton Road, Cambridge, the secretary of the Cambridge Scientists' Anti-War Group, writes, however, to say that his Group considers that with the proposed protection casualties up to 30 per cent of urban populations are likely to occur. This Group is investigating the technical side of the problem, and he suggests that other scientific workers should do likewise and make their results known. These dangers can no longer be ignored, but on the other hand they should not be exaggerated. It is not only sensational journalists who have published misleading statements about new engines of war of extraordinary potency, but even statesmen in responsible positions who are in a position to obtain accurate information. One of these has said that scientific men "will turn to making a high explosive bomb about the size of a walnut and as powerful as a bomb of big dimensions". The actual fact is, however, that every endeavour has failed to produce an explosive appreciably more powerful than nitroglycerine, which was discovered by Sobrero in 1846. Equally exaggerated statements have been made about the effects of gas bombs; but high explosives, incendiary and gas projectiles are all very serious sources of danger and should be investigated authoritatively and impartially.

### Academic Freedom

THE Conference on Academic Freedom held at Oxford on August 14-16 was arranged by the provisional committee formed last October following the censure passed on addresses by Mr. H. D. Dickinson, of the University of Leeds, and Prof. H. J. Laski, of the University of London. The Conference opened with a discussion on academic and professional freedom, over which Prof. J. L. Myres presided, and a standing committee was formed to give permanent character to the protest against any infringement of the rights of academic freedom. Mr. G. D. H. Cole pointed out that, although in Great Britain we are relatively immune from interference with academic and professional freedom, there is a serious danger of a rapid growth of intolerance, and this applies particularly to the professional

worker in business or industry. What is wanted is not to prevent interference altogether but to keep it within the limits within which it is absolutely necessary. The difficulty arises over the exercise of the professional man's rights as a citizen and the rights he holds in common with other people in matters of personal conduct and behaviour. Bertrand Russell made a vigorous plea for freedom for teachers to express their opinions within as well as outside their professional activities, and for organised defence against victimisation.

AT the second session of the Conference, over which Prof. Lascelles Abercrombie presided, the question of international professional relief was discussed. Reports were read dealing with the persecution of teachers of all grades in Italy, Spain and Bulgaria as well as in Germany. Prof. Abercrombie said that internationalism must be identified with civilisation itself. A resolution was passed recognising the need of relief for persecuted teachers in other countries besides Germany, and establishing a committee to co-ordinate such work internationally. The final session of the Conference, over which Prof. Julian Huxley presided, dealt with the utilisation of science, and Prof. Huxley suggested that a long-range policy of the utilisation of science would involve the transformation of the economic and social system. Mr. J. L. Hodgson insisted that no creative work of value is ever done for money, and Dr. L. E. C. Hughes said that if science is to have a broadening humanitarian future and the scientific worker is to have a share of responsibility for his actions, it can only be in accordance with his own standards of scientific procedure and not with those arbitrarily imposed by non-scientific politicians. A resolution was passed to set up a committee of representatives of scientific and technical organisations to co-ordinate the activities of scientific associations and scientific workers in carrying out the pledge to secure that, so far as lay in their power, science should be used only for the benefit of humanity.

### Artificial Radioactivity and Therapeutics

A NOTE in *The Times* of August 24 states that Prof. Ernest Lawrence, of the University of California, reports further progress in the production of artificial radioactivity. By subjecting ordinary salt to high-voltage X-rays, he claims to have produced in his laboratory minute amounts of radio-sodium, which emits radiation only of the  $\gamma$ -type, and has a half-life period of only about 15 hours as compared with the 1700 years of radium, while the suggestion is made that great therapeutic possibilities are thus opened up. The high reputation of Prof. Lawrence leaves us in no doubt as to the validity of his experimental claim; but it seems all the more necessary to suspend judgment about therapeutic possibilities until a vast

amount of experimental biological work has been carried out. It was suggested that it might be possible to inject the radio-sodium into the tissues, apparently with the view of obtaining its local action upon malignant growths. How the localisation is to be effected will, we think, be rather a problem. A further point is that the short half-life period is not necessarily by any means an advantage from the therapeutic point of view. One of the certain facts which have resulted from the scientific study of radiation therapy is that uniform and carefully adjusted dosage is essential to success. The new product—radio-sodium—produces a form of radiation which is rapidly diminishing in amount; constancy of radiation, therefore, cannot be expected. It is certainly by no means the case that an initial heavy dose of radiation which rapidly decreases will have the same biological effect as the same total dose provided by a smaller constant source acting for a longer time. From the physico-chemical point of view, Prof. Lawrence's work is of the deepest interest, but to mention therapeutic possibilities at this early stage seems to us decidedly premature.

#### Red Kafirs of Nuristan

It is anticipated that further light will be thrown on the much-disputed origin of the Bashgali, or 'Red Kafirs' of Afghanistan, by recent investigations of their language and customs by Dr. George Morgenstierne, of the Göteborg High School, Sweden. In the meantime, *The Times* correspondent at Simla reports in the issue of August 17 that a German botanical expedition, which has worked its way through the Hindu Kush to the Chitral, has come into contact with the Red Kafirs among other strange tribes of Nuristan. The Red Kafirs—so-called to distinguish them from the Black Kafirs, whom some ethnologists regard as having negro affiliations—are sometimes credited with an origin which legend traces to Arabia, while on another view it has been suggested that they are descendants of the soldiers of Alexander. The most probable theory is that both racially and culturally they preserve a strain of the same stock as the Aryan invaders of India. Although they have been converted to Islam, they retain a number of pagan customs, in which some would see traces of ancient Greece. It is probable, however, that the resemblance is no more than generic, and that the strange customs reported of them are a debased survival of beliefs of the primitive Arya. Thus it is said that although they believe in one chief god, they also recognise forty or fifty other deities, to whom sacrifices are offered on high places, while the dead are placed in sacred groves. One of the most interesting features of their customs is a song and dance ritual in connexion with a central altar. Dead heroes are commemorated by wooden equestrian statues, which are sometimes accompanied by figures of an attendant and the hero's wives seated behind on chairs. The general character of these statues and their technique have been made the basis of a suggested connexion with the statues of Easter Island, and thought to point to one possible source of the 'Aryan' strain which some would see in Polynesia.

#### Restoration at Avebury

OPERATIONS for the exploration and restoration of the avenue leading from Overton Hill to Avebury, which were begun by Mr. Alexander Keiller last year, have been resumed. It is expected that all the surviving stones of the avenue will shortly have been placed in their original positions. The recent work has yielded information as to the original plan and method of construction additional to that obtained last year. Six stones, it is stated in a report in *The Times* of August 24, have been re-erected this year, including two of the largest megaliths known in the whole of the avenue, and the only two remaining stone-holes in the section have been identified; and at the time of writing two stones were still to receive attention. Of these, No. 9 is the only one which has never fallen. Advantage will be taken of the concreting, which will make it safe for future generations, to examine the method of packing followed when it was erected originally. The companion stone, No. 10, re-erected by Mrs. M. E. Cunnington in 1912, was shown by last year's examination to have been replaced some distance from its original position, as well as back to front and upside down. It will be placed in its correct position in its proper stone-hole, which has recently been discovered. In the next section, excavations are being undertaken on the sites of the stones between the north-western limits of last year's operations and the entrance to the circle. Here evidence has been found to show that at least two of the stone posts were broken up on the spot and without the use of fire. No. 39, partially uncovered in the laying of a pipe-line in 1913, and No. 40 have now been completely excavated, and will be re-erected shortly.

#### Further Discoveries at Colchester

LATER excavation of the remains of the remarkable wall discovered on the Romano-British site on Sheepen Farm at Colchester (see *NATURE*, August 17, p. 251) have served only to strengthen early impressions of its singular character. It has been found to run in an east-west direction for a distance of approximately 352 ft. At the eastern end, the possibility of further examination comes to an end at Sheepen Lane, so that it cannot be stated how far, if at all, it extended in this direction. At the western extremity, after a somewhat sinuous course, the wall turns in a right-angled bend to run northward, the construction continuing to be identical in form. The northern corner of what was evidently a large enclosure was located on this western side at a distance of 291 ft. from the southern turn. The course of the northern face is now being traced. Vestiges of cross walls, one running east and west, the other north and south, have been found at a point situated approximately 150 ft. east of the west wall. Of these, the former is the more substantial, its foundations having a breadth of 4 ft. 6 in., while those of the latter are only 2 ft. 6 in. wide. Further excavation showed these to be part of the walls of a Romano-Celtic temple, of which the enclosure was the *temenos*. The walls of the temple have now been completely traced (*The Times*, August 28).

### Quetta Earthquake of May 31

WE have received from the Under Secretary of State for India an advance copy of a brief report on the Quetta earthquake. In the loss of human life, it ranks as one of the most destructive of all known Indian earthquakes. Its disturbed area was probably less than 300,000 square miles, while the Assam earthquake of 1897, the Kangra earthquake of 1905 and the North Bihar earthquake of 1934 were all felt over areas of between  $1\frac{1}{2}$  and 2 million square miles. The epicentral area is a band about 70 miles long and 15 miles wide, running from Quetta, through Mastung, to midway between Mastung and Kalat. One of the most striking features of the earthquake was its brief duration, which was probably less than half a minute. The intensity of the shock rapidly diminished from the central area, suggesting that the focus was perhaps not more than a mile or two below the surface. In the district between Peshawar and Karachi, the alignment of the mountain ranges is abruptly broken by a marked re-entrant angle running up through Sibi to Quetta. At the apex of this angle, the rocks must be in a condition of great strain, and it is possibly the sudden yielding of the rocks under this strain that causes the numerous earthquakes in this part of Baluchistan.

### Circulation of the Earth's Atmosphere

At the International Meteorological Conference at Utrecht in September 1923, a resolution was passed that arose from a proposal of the late Prof. Exner for the calculation of coefficients of correlation between weather anomalies in distant parts of the world. This resolution was to the effect that long and homogeneous series of observations of pressure, temperature and rainfall should be published with the view of furthering the study of the general circulation of the earth's atmosphere; that a small number of stations at a mutual distance of 500-1,000 kilometres should be included, preferably stations belonging to the Réseau Mondial (a network of stations for which annual summaries are published); and that this material for publication should be collected with the aid of various meteorological institutes, the long series being taken up to the year 1920. This resolution took shape in vol. 79 of the Smithsonian Miscellaneous Collections under the title "World Weather Records", to which has been added recently a supplementary volume with the same title covering the period 1921-30, but also including some summaries of long records that were not available in time for vol. 79. The new material occupies the whole of vol. No. 90 of the same series of Miscellaneous Collections, the cost of publication being met by a grant from Mr. John A. Roebling. It is scarcely necessary to point out the advantage to students of world weather of a collection of data of this kind, which gathers together in a compact form material that is often obtainable only at great trouble and expense. It can be used by those who carry out statistical studies with the view of establishing equations for long-period forecasting on the lines developed by Sir Gilbert Walker and others, and

also for the study of periodicities, while the addition of monthly sunspot and solar radiation data makes it possible to add the study of solar-terrestrial relationships. The supplementary material includes the long Edinburgh series, which goes back to 1731 for temperature and to 1770 for precipitation.

### Marine Research at Port Erin

THE main work at the Marine Biological Station, Port Erin, Isle of Man, has been on the rearing of oyster larvæ up to the time that they settle as spat. The report for 1934 (No. 47), drawn up by Dr. R. J. Daniel, shows that many other researches are being carried out, but the grant-in-aid from the Development Commission has made it possible to investigate the feeding of the oyster larvæ. The zooids from certain common seaweeds have been used, and by choosing a succession of different species, zooids of one kind or another are provided throughout the summer months when the oyster larvæ are present in the water. This special research occupies Mr. J. A. Bruce and Dr. Mary Parke. Detailed investigations on the morphology, cytology and life-cycles of the brown seaweeds have been necessary, with the testing of various culture media. The results have so far been of an encouraging nature, and it is hoped to expand the scope of the work in future. Samples of local herring are still continuously examined throughout the fishing season. Lobster culture is also progressing, lobsterlings and younger stages as well as more than 3,000,000 plaice eggs and larvæ from the pond having been liberated into the sea. The scheme for research also includes work on the conditions and relations of inter-tidal life on the beach. It is satisfactory to see that a large number of visitors, especially classes from schools, have worked at the Laboratory during the year.

### Problems of Forestry

THE fifteenth number of *Sylva* (published by the Edinburgh University Forestry Society, 1934-35), the annual journal of the Edinburgh University Forestry Society, fully maintains the standard which this publication has achieved. Among the professional articles may be included "Impressions of British Forestry", in which some interesting criticisms are made by H. E. Marées, and a second on "The Forests of Denmark", by N. Bang. Forestry in the Empire is represented by articles on "Forest Research in Trinidad", in which C. Swabey treats of the considerable progress made in this direction in recent years; the "Problem of Forestry in Southern Rhodesia", an article recommended to those interested in that portion of the Empire. Afforestation on the Bauchi Plateau of Northern Nigeria, by J. Dundas, and preliminary notes for a working plan of woodbush forests in South Africa, by C. C. Stapleton, are also discussed. Allusion is also made to the visit paid to West Africa in 1934 by Prof. E. P. Stebbing, during which he saw something of the forests of a number of British and French Colonies, returning home via the Sahara.

### Tropical Diseases Research in Puerto Rico

THE eighth annual report of the Director of the School of Tropical Medicine of the University of Puerto Rico (under the auspices of Columbia University), recently received, summarises the work of the School during the year ending June 1934. Seminars, lectures and clinics are held weekly in the School, and the Pan-American Medical Association visited the School in March. Much research work has been done, of which an outline is given. This includes a study of tuberculosis and its occurrence in the Island, and a skin test for *Brucella* infection has been developed. In the Department of Chemistry, work on vitamin A testing of Puerto Rican food plants has been completed. In parasitology, special methods for detecting ova of *Schistosoma mansoni* have been devised, and some cases of human infection with the liver-fluke, *Fasciola hepatica*, have been detected. In mycology, infection with new species of ringworm organisms has been found, and the disease known as granuloma inguinale has been investigated. A list of the papers that have been published from the School is appended, together with details of administration and finance.

### Twenty-Five Years of Philosophy

IN recognition of the Royal Silver Jubilee, movements in British philosophy during the past twenty-five years have recently been reviewed in the *Philosopher* (13, No. 3, July 1935). In 1910, Bertrand Russell and A. N. Whitehead crystallised the logistic tradition and created the analytic method. The neo-realist creed has been developed by Russell, and the great principle of emergence has taken an important place in modern philosophy, chiefly through the work of C. Lloyd Morgan. These and other systems are, however, opposed by the concept of idealism, the greatest British supporter of which is F. H. Bradley. This reaction against materialism has received much support from British thinkers. Bradley supports absolute idealism, which is closely related to the philosophy of the Hegelians such as Sir James Baillie, Viscount Haldane, etc. Idealism has also found great favour among leading men of science like Sir Arthur Eddington and Sir James Jeans. The antagonism between spiritualism and materialism is exemplified in the controversies concerning animate Nature—vitalism and mechanism. L. T. Hogben supports the latter, but opposed to his views are those of Sir J. Arthur Thomson and J. S. Haldane, who claim the independence of biology from physics. The past twenty-five years has witnessed a welcome approach of philosophy, religion and the positive sciences.

### Early Books on the Hyacinth

UNDER the title "The Voorhelms of Haarlem", Mr. W. Roberts gives an interesting account of some of the Dutch bulb growers, and their literary efforts, during the eighteenth century (*J. Roy. Hort. Soc.*, 60, Part 3, pp. 199-208, May 1935). The Dutch trade in bulbs was established in the seventeenth century, upon a basis of secrecy. The "Dutch Gardener or the

Complete Florist", a book by Henry Van Oosten, published in London in 1703, devoted four pages to the hyacinth and forty to the tulip, but gave away none of the precious information. The publication of "A Treatise on the Hyacinth" by George Voorhelm, in 1752, broke the tradition, and, far from ruining the Dutch trade in bulbs, laid the foundation for development to its present magnificent proportions. The volume was translated into English, French, Italian and German, though no Dutch edition was apparently needed. It was the first scientific treatise on bulb culture, but Mr. Roberts cites many more later volumes on the same subject, and also outlines, in pleasing style, the later development and fortunes of the house of Voorhelm.

### Estimation of Small Percentages of Bismuth

IN view of the need for a generally agreed and reliable method of analysis for the small percentages of bismuth in copper, the Fiscal Policy Joint Committee, Brass, Copper and Nickel Silver Industries in 1933 enunciated, through a specially appointed Technical Sub-Committee, a number of analytical principles to be observed in the estimation. This has now been followed by a detailed method for the determination of quantities of bismuth of the order of 0.0002-0.005 per cent, based upon published literature on the subject, and the Secretary of the Committee, the address of which is Kings Court, 115 Colmore Row, Birmingham, invites comments from any who are interested.

### Mining in South Australia

THE "Mining Review" of the Department of Mines of South Australia for the half-year ending June 30, 1934, shows that there has been considerable activity in gold mining, due, of course, to the increase in the value of the product. Thus the quantity of gold obtained in 1933 was slightly more than double that obtained in 1932, but its value was considerably more than double that obtained in the previous year, being in fact approximately in the proportion of 7 to 3. There is also included in the pamphlet a description of a motor-driven rotary drill which has been devised, owing to the difficulty of obtaining fuel and boiler water for the ordinary steam-driven rotary drill.

### International Congress of Americanists

OWING to local difficulties, the twenty-sixth session of the International Congress of Americanists, which should have taken place in 1934, at Seville, was postponed; and at one time it was thought that no meeting would be possible before 1936. Arrangements, however, have been made for the Congress to open at Seville on October 12 next. A programme is being arranged by the Organising Committee, of which S. Gregorio Marañón, president of the Geographical Society, is chairman. The topics selected for discussion include the relations of the individual and the State in the early Spanish expeditions of discovery, conquest and colonisation; types of cities in Spanish America in the colonial period, and the functions of the Hispano-American municipality; social and juridical conditions of the Indians in the

Spanish colonial period: the critical study of the scientific work as regards geographical knowledge of Spanish America accomplished by the Supreme Council and the "Casa de Contratacion" of Seville; and fundamental problems in the archæology, ethnography and philology of pre-Columbian America. The subscription has been fixed at 25 pesetas. All communications relating to the Congress should be addressed to S. Jose Maria Torroya, General Secretary, calle del Leon, 21, Madrid.

#### An Active Sunspot

A RECENT feature of interest on the sun's disc has been a group of sunspots that appeared suddenly near the central meridian between August 19 and 20. Its growth is shown as follows, the unit of area being one millionth of the sun's hemisphere:

Date	U.T.	Area	} Heliographic position: long. 356°; lat. 28° N.
Aug. 19 <sup>d</sup>	8 <sup>h</sup>	0	
20	8	250	
20	11	350	
21	8	700	
22	8	800	

On being observed with the Hale spectroheliograph at the Royal Observatory, Greenwich, the group was obviously very active, especially about the following times: Aug. 20<sup>d</sup> 13<sup>h</sup><sub>3</sub>; Aug. 21<sup>d</sup> 8<sup>h</sup><sub>1</sub> and 9<sup>h</sup><sub>1</sub>–10<sup>h</sup>; Aug. 22<sup>d</sup> 9<sup>h</sup>. During the time that the spots were under observation, there were also continuous minor changes, often too rapid to record in detail, but sometimes producing quite obvious changes in the configuration of the accompanying hydrogen flocculi in less than an hour. On August 21 a stream of relatively dark hydrogen continued for about two hours from 8<sup>h</sup><sub>1</sub> to descend with a radial velocity of 40–50 km./sec. behind the leader spot. About 10<sup>h</sup> on the same day, after a portion of the flocculi had shown a sudden brightening, a narrow stream of dark hydrogen was shot upwards with a maximum velocity of 140 km./sec., but this faded in about 10 minutes. If this phenomenon had occurred at the edge of the sun, the profile aspect would doubtless have been an eruptive prominence rising to a considerable height.

#### The Sky in September

As an offset to the perceptibly shortening days, September provides in the latitude of the British Isles unexcelled night skies to those who search with binoculars or merely use their eyes. By the middle of the month at 21<sup>h</sup> U.T. (=22<sup>h</sup> Summer Time), the great triangle formed by Vega, Deneb, and Altair is not far past culmination, whilst crossing the zenith obliquely to the meridian is the Milky Way—a brilliant sight when the moon does not interfere. Arcturus, nearing the north-west horizon, is balanced by Capella in the north-east, and after midnight the Pleiades, Aldebaran, and the head of Orion make the low eastern sky conspicuous. There are also other gems, such as the tiny constellation, Delphinus, the double star cluster in Perseus, and the well-known double star,  $\beta$  Cygni. The moon is full on September 12 at 12<sup>h</sup>, and in this lunation becomes the 'harvest moon'. On September 7 it occults  $\lambda$  Sagittarii (magnitude 2.9), the disappearance of the star

taking place in twilight at 19<sup>h</sup> 29.5<sup>m</sup> and the re-appearance at 20<sup>h</sup> 35<sup>m</sup>. Saturn is the only planet at all well placed for observation; in the middle of the month it transits about 23<sup>h</sup>. The ring system appears about half-way open. On September 12<sup>d</sup> 3<sup>h</sup>, the planet is in conjunction with the moon. Venus is at inferior conjunction with the sun on September 8, when the planet passes 8° south of the sun's centre; a thin crescent may then be observed telescopically. The variability of Algol ( $\beta$  Persei) may be observed within about 1½ hours before and after the following times: September 4<sup>d</sup> 23.6<sup>h</sup>, 7<sup>d</sup> 20.4<sup>h</sup>, 25<sup>d</sup> 1.3<sup>h</sup>, 27<sup>d</sup> 22.1<sup>h</sup> and 30<sup>d</sup> 18.9<sup>h</sup>. The sun enters the sign Libra (Autumnal Equinox) on September 24<sup>d</sup> 0<sup>h</sup>.

#### Announcements

DR. MARSHALL A. HOWE has been appointed director of the New York Botanical Garden as from October 1, in succession to Dr. E. D. Merrill, who has been appointed head of the Botanical Department, Harvard University. Dr. Howe has been assistant director of the Gardens since 1923. He has made several field excursions, especially to Newfoundland and the West Indies, and is an authority on the Hepaticæ and marine Alge of North America.

THE second International Speech Congress will be held in Brussels on September 6–8, under the presidency of Mlle. Hélène Vacaresco, permanent delegate of Roumania at the League of Nations. The subjects for discussion will be instruction in speech, results obtained by the former congress, international exchange of lectures, and French as a universal language. The fee is 20 francs. Further information can be obtained from L'Agence Joseph Dumoulin, 77–79 Boulevard Adolphe Max, Brussels.

A BOOK by Dr. F. W. Lanchester on "Relativity" will be published by Messrs. Constable and Co., Ltd., on September 5. It presents the theory of relativity and the relationships of space, time and gravitation, in language suited to those who, though not highly specialised in mathematics, wish to grasp the meaning of four-dimensional space-time.

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

An assistant vocational guidance officer to the Kent Education Committee—The Director of Education, Springfield, Maidstone (Sept. 7).

An assistant agricultural organiser to the Notts Education Committee—The Director of Education, Shire Hall, Nottingham (Sept. 11).

A mechanical engineer to the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, Millbank, London, S.W.1 (Sept. 14).

An assistant librarian in the University of Aberdeen—The Secretary (Sept. 30).

A research fellow, two junior research assistants, and three junior laboratory assistants to the Wool Industries Research Association—The Secretary, Torrion, Headingley, Leeds, 6.

## 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. 341.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

### Attempts to Produce Helium 3 in Quantity

WITH reference to the results published by Harnwell, Smyth and Urry<sup>1</sup> in which there is an apparent production of helium of atomic weight 3 in considerable quantities ( $10^{-5}$  c.c.) in a discharge run in heavy hydrogen, we should like to mention some experiments which we have made during the past year on similar lines. Our apparatus resembles that used by Rutherford and Oliphant<sup>2</sup>, a beam of positive rays being directed on to a target containing heavy hydrogen, the positive rays being produced by an auxiliary discharge in heavy hydrogen gas. The voltage applied to the rays was about 150 k.v., the auxiliary discharge carried about 8 milliamp. and the current in the beam was of the order of 100 microamp., but probably only a small proportion of this consisted of ions of heavy hydrogen.

After running for one hour, the gas was pumped into a glass reservoir which was then sealed off and the gas analysed by the micro-method of Paneth and Peters. A number of such bombardments were made and in all cases the hydrogen contained helium and neon, the ratio of helium to neon being greater than that in ordinary air. We consider that this gas was derived from the walls of the glass cylinder used for the discharge, and that the enhanced proportion of helium is due to the fact that any glass in contact with air adsorbs and dissolves helium in preference to neon<sup>3</sup>. The release of this helium is facilitated by the presence of hydrogen.

Our reasons for preferring this explanation are two. First, the yield of neutrons, which should accompany the production of helium 3, was measured and found to be only equivalent at best to a source of 60 milluries of (radon + beryllium); the helium corresponding to this yield of neutrons would not exceed  $10^{-10}$  c.c. in the hour, while  $10^{-8}$  -  $10^{-7}$  c.c. of helium were commonly observed. Secondly, interferometric analysis of the helium spectral lines carried out by Mr. C. V. Jackson showed no sign of any extra doubling of the lines such as might be expected if any considerable proportion of the helium had a mass of only 3. For this analysis the helium + neon samples from five bombardments were united; the mixture consisted of about  $1 \times 10^{-7}$  c.c. neon and  $3.6 \times 10^{-7}$  c.c. helium, of which at least 90 per cent was ordinary helium of mass 4. It would not have been possible to detect less than 10 per cent of helium of mass 3 on account of the difficulty of photographing fringes with so small a quantity of gas.

A short recent communication by Smyth, Harnwell, Bleakney and Lozier<sup>4</sup> appears to throw doubts on the interpretation of the evidence from the mass-spectrograph described in the earlier paper. They state, however, that their spectroscopic evidence for

the production of helium remains entirely unexplained. We venture to suggest that their results may be explained in the same way as the very similar ones which we have obtained.

F. A. PANETH.  
G. P. THOMSON.

Imperial College of Science and Technology,  
London, S.W.7.

<sup>1</sup> G. P. Harnwell, H. D. Smyth and Wm. D. Urry, *Phys. Rev.*, **46**, 437; 1934.

<sup>2</sup> M. L. Oliphant, P. Harteck and Lord Rutherford, *Proc., Roy. Soc., A*, **144**, 692; 1934.

<sup>3</sup> F. Paneth and K. Peters, *Z. phys. Chem.*, **B**, **1**, 253; 1928.

<sup>4</sup> H. D. Smyth, G. P. Harnwell, W. Bleakney and W. W. Lozier, *Phys. Rev.*, **47**, 800; 1935.

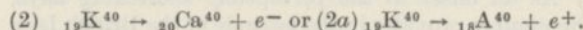
### Radioactivity of Potassium

SEVERAL hypotheses have been put forward<sup>1</sup> to explain the extremely long life-period of potassium, which conflicts with the theories of  $\beta$ -decay as well as with Sargent's empirical rule. Klemperer<sup>2</sup>, however, has shown by an investigation in detail that none of the processes suggested really exists. He concludes from his experiments that an unknown, relatively rare isotope,  $_{19}\text{K}^{40}$ , is responsible for the  $\beta$ -activity of potassium, and similarly an unknown isotope  $_{37}\text{Rb}^{86}$  in the case of rubidium.

On general principles, it can be said that  $\beta$ -decay will be possible, if the difference in the energies of the initial and final nucleus,  $\Delta E$ , fits the relation:

$$(1) \quad \Delta E > (m + m')c^2,$$

where  $m$ ,  $m'$  are the masses of the two particles involved in the process. Hence, in the case of  $_{19}\text{K}^{40}$ , one would expect both positive and negative electrons leaving the nucleus, due to the processes



Both  $_{20}\text{Ca}^{40}$  and  $_{18}\text{A}^{40}$  are well-known, stable nuclei; and  $_{18}\text{A}^{40}$  is relatively the most frequent isotope of argon. This means that the binding energy of the nucleus  $_{18}\text{A}^{40}$  must be sufficiently low, and the relation (1) would scarcely be violated for the process (2a), if it is valid for the process (2).

Experiments hitherto have not shown any proof of an emission of positrons from potassium. I have also tested the radiation of potassium in a cloud-chamber, without finding any track of positively-charged particles. My experiments will be continued, and the results published in the *Zeitschrift für Physik*, but it does not seem to be very probable that any  $\beta^+$ -emission will be found.

On the other hand, a simple  $\beta$ -decay of  $_{19}\text{K}^{41}$  cannot be expected. The final product of this process,  $_{20}\text{Ca}^{41}$ , does not accord with our general knowledge of the system of stable isotopes<sup>3</sup>. Besides, the decay constant for this process would be lowered by a factor

of about 100 compared with the decay process of the rare isotope  $^{19}\text{K}^{40}$ , and the disagreement would be still more emphasised. We know further that an isotope  $^{19}\text{K}^{42}$  cannot be responsible for the natural  $\beta$ -activity of potassium, for this isotope was produced artificially by Hevesy<sup>4</sup> and its half-period found to be about 16 hours. Therefore one comes to the conclusion that another relatively rare isotope of potassium exists, which is the source of the  $\beta$ -particles. This can only be  $^{19}\text{K}^{43}$ , which is transformed by the decay process to the well-known isotope  $^{20}\text{Ca}^{43}$ . This seems to be the only assumption not in conflict with all the available experimental evidence.

K. SITTE.

Department of Physics,  
German University,  
Prague.  
July 18.

<sup>1</sup> G. Gamow, *NATURE*, **133**, 869; 1934. G. Beck and K. Sitte, *NATURE*, **133**, 722; 1934.

<sup>2</sup> O. Klemperer, *Proc. Roy. Soc., A*, **145**, 638; 1935.

<sup>3</sup> J. Mattauich, *Z. Phys.*, **91**, 361; 1934. K. Sitte, *ibid.*, in print.

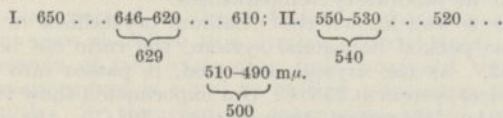
<sup>4</sup> G. Hevesy, *NATURE*, **135**, 96; 1935.

### Spectroscopy of an Enzyme Reaction

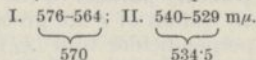
IF a suitable amount of monoethyl-hydrogen peroxide is added to an active preparation of liver catalase at pH 7, the enzyme spectrum disappears instantly, and two new absorption bands in the green range of the spectrum appear. In the course of a few minutes, at room temperature, the new absorption bands decrease in intensity, and simultaneously the original enzyme spectrum reappears. When the change is complete, the cycle may be repeated by the addition of fresh substrate. The time required for the reaction cycle at 4° is four times that required at 24°. The reappearance of the enzyme spectrum is accompanied by the disappearance of the titratable peroxide oxygen from the system. No gas is evolved in this reaction. Acetaldehyde and ethyl alcohol are among the most probable reaction products.

The spectrum of the intermediate compound is to be attributed to a combination of the enzyme with the substrate. The alternative explanation that one is dealing here with the reduced (ferrous-) form of catalase can be discarded because neither molecular oxygen nor ferrieyanide reoxidise it to the original ferric form, and because it does not combine with carbon monoxide.

Enzyme spectrum (after K. Zeile):



Spectrum of the enzyme-substrate compound:



$5 \times 10^5$  molecules of the substituted peroxide per enzyme molecule are required to complete the transformation into the intermediate compound. It is interesting to note that according to J. B. S. Haldane's calculations<sup>2</sup>, based on Zeile's and Euler's data,  $1.9 \times 10^5$  molecules of hydrogen peroxide are destroyed by one molecule of liver catalase per second under optimal conditions. This coincidence is still more striking since the enzyme is at least 5,000 times more active towards hydrogen peroxide than towards ethyl-hydrogen peroxide.

With hydrogen peroxide as a substrate, no apparent change of the enzyme spectrum is observed. The inference is, that since the rate of formation and the stoichiometry of the two enzyme-substrate complexes seem to be similar, the different catalytic efficiency towards the two substrates is due to the different velocity constants of the breakdown of the intermediate compounds.

A non-enzymatic model of the present observation is found in the reaction of methæmoglobin with hydrogen peroxide (Kobert<sup>3</sup>, Haurowitz<sup>4</sup>) and with monoethyl-hydrogen peroxide. Here the intermediate compounds are similar to that observed above, so far as the absorption spectrum is concerned. But one molecule of methæmoglobin will only break up  $3.6 \times 10^{-2}$  molecules of hydrogen peroxide per second (cf. K. G. Stern<sup>5</sup>), and an excess of only 20 molecules of hydrogen peroxide (Haurowitz, l.c.) and of 8 molecules of monoethyl-hydrogen peroxide will suffice to transform completely the spectrum of this catalyst into that of the intermediate compounds.

KURT G. STERN.

Courtauld Institute of Biochemistry,  
Middlesex Hospital Medical School,  
London, W.1.

Aug. 14.

<sup>1</sup> K. Zeile and H. Hellstrom, *Z. physiol. Chem.*, **192**, 171; 1930.

<sup>2</sup> J. B. S. Haldane, *Proc. Roy. Soc., B*, **108**, 559; 1931.

<sup>3</sup> Kobert, *Pflüger's Archiv*, **82**, 603; 1900.

<sup>4</sup> F. Haurowitz, *Z. physiol. Chem.*, **232**, 159; 1935.

<sup>5</sup> K. G. Stern, *ibid.*, **215**, 35; 1933.

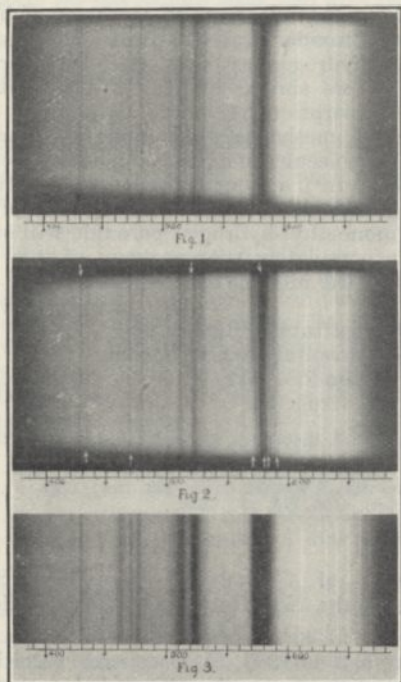
### Pleochroism of Crystals of Rare-Earth Salts as Evidence of the Non-Rotation of Certain Electronic Orbits

So long ago as 1888, H. Becquerel<sup>1</sup> recorded that the absorption spectrum afforded by crystals of 'didymium' salts was different for different vibration planes of the incident light. Later, M. H. Dufet<sup>2</sup> made a detailed study of the crystallographic and optical properties of neodymium, praseodymium and samarium sulphates, in the course of which he confirmed and extended Becquerel's observations by recording the wave-lengths of bands in the absorption spectra of these salts for light vibrating parallel to the acute bisectrix, obtuse bisectrix and optic binormal respectively. He found that the intensity of individual absorption bands was often, though not invariably, different for the three principal vibration planes, even to the extent of their being absent from one of them.

In the course of a study of the relationship between the optical properties and chemical constitution of certain absorbing crystals by means of a grating microspectrograph used in conjunction with a polarising microscope<sup>3</sup>, I have had occasion to examine the absorption spectra for various vibration directions in crystals of neodymium, praseodymium and samarium sulphates, and in ceric ammonium sulphate. The method adopted was to project a conoscopic ('directions') image of the crystal on the slit of the microspectrograph by means of a Bertrand lens, using a polariser but no analyser; and ensuring that the slit and the vibration plane of the polariser were parallel to a principal vibration plane of the crystal. An oil-immersion objective of  $N.A. = 1.30$ , in conjunction with an oil-immersion condenser, was used.

In this way it was possible to obtain absorption spectra which showed the effect of varying the ray

direction on the absorption bands. The results now obtained are exemplified by the absorption spectra here reproduced of crystals of neodymium sulphate. In Fig. 1 the slit and plane of vibration are parallel to the plane of the optic axes. In Fig. 2 they are perpendicular to this plane. By way of comparison the absorption spectrum of an aqueous solution of the salt is given in Fig. 3. The relations between



FIGS. 1-3.

the ordinates of Figs. 1 and 2 and the ray direction are shown in stereographic projection in Figs. 4 and 5 respectively, in which the plane of vibration is parallel to the slit.

Fig. 1 shows that there is no marked change in the absorption spectrum on passing from vibration directions parallel to  $Z$  to those about half way between  $Z$  and  $X$ , but Fig. 2 shows that some

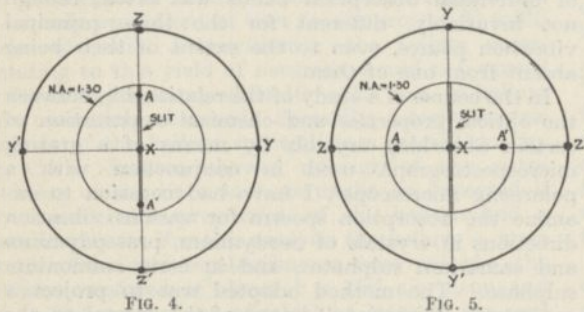


FIG. 4.

FIG. 5.

absorption bands show marked change on passing from vibration directions parallel to  $Y$  to those intermediate between  $Y$  and  $X$ . What is particularly important is that the bands fade out at different points, and that the directions for minimum absorption do not correspond with an axis of the Fresnel wave surface. In all, eleven crystals of neodymium sulphate were examined, but they all gave the same result. The positions of the bands agree, for the

principal optical planes with those recorded by Dufet, with the exception that the present spectrograms do not show the bands from 622.5 to 638.0  $m\mu$  which he has described. Praseodymium sulphate behaved in an exactly analogous manner. A discussion of this, and of the results obtained with other absorbing crystals, will be published later.

It has been shown that the absorption bands of rare-earth salts are due to the incomplete  $N$  shell of electrons ( $4f$  orbits), and as the present work shows that light of certain wave-lengths is not absorbed when its plane of vibration is in certain specific directions, it seems reasonable to assume that the orbits of at least some of the  $N$  electrons are fixed in relation to the crystal structure. As these are not valency electrons, it is probable that the metal ions as a whole are not capable of free rotation in the crystals examined.

I am indebted to Sir William Pope for a gift of rare-earth salts, and to Prof. J. R. Partington for the interest he has taken in this work.

EDWIN E. JELLEY.

Kodak Research Laboratories,  
Harrow.  
July 15.

<sup>1</sup> H. Becquerel, *Ann. Chim. et Phys.*, VI, 14, 208; 1888.

<sup>2</sup> M. H. Dufet, *Bull. Soc. franc. Mineralogie*, 24, 373; 1901.

<sup>3</sup> E. E. Jelley, *Phot. J.*, 74, 514; 1934.

#### Diamagnetism of Thallium Single Crystals

WHILE several investigators have determined the susceptibilities of polycrystalline metals, measurements on single crystals have been rather few<sup>1</sup>. Bismuth crystals have been prepared and studied with great care by Focke<sup>2</sup>, while single crystals of a few other metals like zinc, tin and antimony have been examined by McLennan and his collaborators<sup>3</sup>. We have recently succeeded in making measurements of the diamagnetism of single crystals of some metals; and the results obtained with thallium are of particular interest.

Single crystals of this element were prepared by the method of slow cooling in a manner similar to that of McLennan<sup>3</sup>. They were investigated with a magnetic balance specially devised for the purpose, wherein the Gouy force on the cylindrical specimen was compensated electro-dynamically. Measurements could be made rapidly and to within 0.5 per cent at laboratory temperatures.

It is well known that thallium crystallises in the close packed hexagonal system, the ratio  $c/a$  being 1.62. As the crystal is heated, it passes into the cubical system at 235° C. Our experiments show that, at the laboratory temperature (30° C.), the diamagnetic susceptibility parallel to the hexagonal axis ( $\chi_{\parallel}$ ) is 0.407 (all values of  $\chi$  are given in  $10^{-6}$  units) and the value perpendicular to it ( $\chi_{\perp}$ ) is 0.163. This gives a magnetic anisotropy of 2.50, which is larger than the corresponding values of other similar metals. The average value for polycrystalline thallium works out at 0.244, which is almost identical with Honda's value<sup>1</sup> of 0.24.

On heating the crystal, we find that the susceptibilities in the two directions remain constant up to 235° C. At this temperature, the mean value decreases suddenly to 0.170 and remains the same for all orientations of the crystal in the magnetic field. It is interesting to observe that while  $\chi_{\perp}$  remains nearly the same, it is the susceptibility



value in the other direction that shows a large fall, indicating probably that the movements of atoms when the close packed hexagonal type is changed into the face-centred cubical type are predominantly in this direction. On melting the crystal at 302° C., the diamagnetic susceptibility shows a still further decrease, reaching a value of 0.153 in the liquid state.

The chemical properties of thallium indicate that it is both trivalent and monovalent. The hexagonal structure is obviously due to the three valency electrons (6s and 6p) operating in the crystal binding, while in the cubic structure, only the single valency electron (6p) is active. It is surprising that in both cases the metal is diamagnetic and the diamagnetic susceptibility is independent of temperature in the temperature ranges concerned.

The plausible explanation seems to be that in the hexagonal structure, the electron binding is partly homopolar and partly metallic; while only the latter type of binding is prevalent in the cubical structure.

It is interesting to note that, while the atomic diamagnetic susceptibility of thallium is 34.75 according to these measurements, the susceptibility of the monovalent thallium ion ( $Tl^{+1}$ ) is 38.75, after Kido<sup>4</sup>. This would lead to the conclusion that the single valency electron contributes a paramagnetic susceptibility of +4 per gram atom, a value which is of the same order as those obtained for copper, silver and gold<sup>5</sup>.

Experiments with single crystals of other metals are in progress and the results will be published shortly elsewhere.

S. RAMACHANDRA RAO.  
K. C. SUBRAMANIAM.

Annamalai University,  
S. India. June 12.

<sup>1</sup> Stoner, "Magnetism and Matter", pp. 505-509.

<sup>2</sup> *Phys. Rev.*, **36**, 319; 1930.

<sup>3</sup> *Proc. Roy. Soc., A*, **121**, 9, 1928; *Trans. Roy. Soc. Canada*, **23**, 159; 1929.

<sup>4</sup> *Sci. Rep. Tôhoku Univ.*, **22**, 835; 1933.

<sup>5</sup> *Ref. 1*, p. 511.

### Measurement of the Elastic Constant of Isotropic Transparent Solids

ULTRA-SONIC waves in liquids or transparent solids may be demonstrated visually by a method developed by the author and his co-workers<sup>1</sup>. Ultra-sonic waves produce a regular (sinuous) distribution of density, which gives optically an effect similar to a large number of cylindrical lenses. A parallel beam of light passing normal to the direction of the ultra-sound converges therefore to a system of focal lines. The distance of two succeeding lines produced by stationary waves is equal to half an ultra-sonic wave-length; in the case of progressive waves, which must be observed by means of a high-frequency stroboscope, the distance equals one wave-length.

By measuring the distance of a great number of focal lines it has been possible to obtain the values of ultra-sonic velocities in liquids with very high precision<sup>1</sup>. Measuring ultra-sonic velocity in glass, I have sometimes used polarised light. On one occasion, K. H. Hoesch and I made an unexpected observation. If the electric vector of the polarised light entering an oscillating cube of glass was normal to the front of the ultra-sonic waves, we observed by means of a second nicol—crossed to the polariser—a system of lines similar to that observed in natural light; or in polarised light the electric vector of which had an angle of about 45° with the wave front,

but with smaller separation. As the system of narrow lines could not be observed in natural light, I concluded that it could not have been produced by a longitudinal wave, but only by a transverse wave. That the nodal lines of the transverse wave may be seen by means of two crossed nicols is due to double refraction in the position of maximal elastic strain, just as in an old experiment by Tyndall.

Measurements of the higher harmonics of a longitudinally oscillating piezo-electric quartz crystal have proved that the higher harmonics have no anharmonic deviations between each other, but a pronounced deviation from the fundamental. This seems to indicate that the velocity of longitudinal waves tends towards a limit. As the wave-length for the high harmonics is small compared to the thickness of the quartz, it is natural to assume that this limit is given by the velocity in the medium extending indefinitely in all directions. I therefore assumed (1) that the narrow lines observed were produced by transverse waves in the glass, the other lines by compressional waves; and (2) that for both waves the formulæ for the velocity in a homogeneous isotropic medium extending indefinitely in all directions would be valid with a very good approximation, because the wave-length was very small compared to the thickness of the glass.

This hypothesis made it possible to calculate the elastic constants of the glass from the measurements of the separations of the observed lines and the frequency of the oscillations. At the high frequencies used—for example, 4,894 k.c.—one gets the adiabatic elastic constants, which are slightly higher than the isothermal. For glass which had an isothermal Young's modulus of 7,471 kgm. mm.<sup>-2</sup>, the adiabatic modulus was found to be 7,531 kgm. mm.<sup>-2</sup>. The agreement is too good to be accidental. Poisson's ratio was 0.2072 and the modulus of rigidity = 3,119 kgm. mm.<sup>-2</sup>. Measurements on cubes and bars of other kinds of glass have also given very satisfactory results.

The values given above are only the results of preliminary measurements; their precision is therefore not much better than 1 per cent. It is possible, however, to get a precision of better than 1 in 1,000; Poisson's ratio may even be measured to about 1 in 10,000, a precision never obtained before.

The method is now being applied to the study of high-frequency oscillations of cubes and bars of glass, and an account of the investigation will be given elsewhere.

E. HIEDEMANN.

Abteilung für Elektrolytforschung,  
Universität, Köln.  
July 25.

<sup>1</sup> Ch. Bachem, E. Hiedemann and H. R. Asbach, *NATURE*, **133**, 176; 1934. Ch. Bachem and E. Hiedemann, *Z. Phys.*, **94**, 68; 1935. E. Hiedemann and K. H. Hoesch, *Naturwiss.*, **23**, 511; 1935. Also other papers in *Z. Phys.*

<sup>2</sup> E. Hiedemann, H. R. Asbach und K. H. Hoesch, *Z. Phys.*, **90**, 322; 1934. L. Bergmann, *Ann. Physik.*, **21**, 553; 1935.

### A New Wave Characteristic of Deep-focus Earthquakes

A PROMINENT phase appearing a few minutes after *ScS* on the seismograms at the Dominion Observatory, Wellington, of seven deep-focus earthquakes in the south-west Pacific, has been identified as a transverse wave reaching the station after having been reflected, first at the earth's surface near the epicentre, and then at the boundary of the core.

The designation of such a phase in accordance with current nomenclature would be *sScS*. This phase does not appear to have been recorded on any previous occasions. It is similar in character to *ScS*, and both are remarkably prominent on some of the seismograms.

The time-interval (*sScS-ScS*) provides a comparatively accurate method for determining the focal depths of abnormally deep earthquakes from a single seismogram at short epicentral distances: the interval being practically independent of epicentral distance.

R. C. HAYES.

Dominion Observatory,  
Wellington, N.Z.

### The Oblong Sunfish (*Ranzania*) in the Indian Ocean

DR. E. W. GUDGER, of the American Museum of Natural History, recently referred in *NATURE* (April 6, 1935, p. 548) to the occurrence of *Ranzania* in the Indian Ocean, his only record being based on an original painting from Mauritius by Nicholas Pike.

The Australian Museum possesses two specimens of the oblong sunfish from the Indian Ocean: (1) a small example from Mauritius, of which I have published a sketch<sup>1</sup>, and (2) a larger specimen from near Albany, Western Australia, whence the species had been recorded by McCulloch in 1910. Other records of this fish have been tabulated by me<sup>2</sup> in an account of its synonymy.

Apart from the few recorded specimens from Mauritius and Western Australia, there are few references to this fish in the Indian Ocean region. Thus Pennant in 1798 listed "*Balistes truncatus*" from Ceylon and this, like the sunfish in Day's Supplement to his "Fishes of India", may have been a *Ranzania*. Also in 1798, Lacépède described a *Ranzania* from a drawing by Commerson, who probably painted it in Mauritius. Dr. J. Pearson published a note and a photograph of a sunfish (Pearson, *Spolia Zeylanica*, 7, 208 and fig.; 1911) from near Jaffna, Ceylon, which is easily recognisable as a *Ranzania*.

Dr. Gudger has requested me to direct attention to these records, bibliographical references to which will be found in the papers quoted.

GILBERT P. WHITLEY.

Australian Museum,  
Sydney. June 14.

<sup>1</sup> Whitley, G. P., "Sunfishes", *Victorian Naturalist*, 49, 207-213, fig. 6; 1933.

<sup>2</sup> Whitley, G. P., "Studies in Ichthyology, No. 7," *Rec. Australian Mus.*, 19, 108-111; 1933.

### Life-History of *Butomopsis lanceolata*, Kunth.

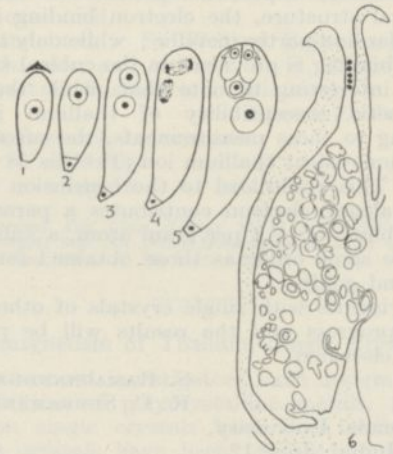
MEMBERS of the family *Butomaceae* have received little attention, although several genera and species of the closely allied family *Alismaceae* have been thoroughly worked out. Recently I had an opportunity of investigating the life-history of *Butomopsis lanceolata*, material of which was kindly supplied to me by Mr. A. C. Joshi of Benares.

The development of the male gametophyte follows the normal course. There are two definite male cells and a tube nucleus in the mature pollen grain.

The development of the female gametophyte presents some interesting and unusual features. The hypodermal megaspore mother-cell divides to form a small ephemeral cell at the top and a larger cell below, which develops into the embryo-sac (Fig. 1). Of the two nuclei resulting from the first division,

the primary chalazal nucleus is very small, and may sometimes be cut off by a wall (Fig. 2). It degenerates very early and may be said to represent the single antipodal cell the remains of which can be seen up to the time of fertilisation. The primary micropylar nucleus divides twice and produces four nuclei, three of which organise into a normal egg-apparatus and the fourth is the upper polar nucleus (Figs. 3-5); the lower polar is missing.

Double fertilisation occurs. The endosperm is of the Helobiales type, as also reported for *Echinodorus macrophyllus* by Dahlgren<sup>1</sup>. Sometimes supernumerary bodies resembling the sperm nuclei have also been seen in the pollen tube. These are similar to the X-bodies described by Artschwager<sup>2</sup> for the sugar beet.



FIGS. 1-5. Schematic representation of the development of the embryo-sac of *B. lanceolata*. FIG. 6, longitudinal section of the ovary, showing pollen grains in the stylar canal.

A very striking phenomenon was observed in connexion with pollination. Usually the pollen grains germinate on the stigma, but in some favourable preparations a few were found *inside the hollow stylar canal* (Fig. 6), and *even inside the ovary*. In one case a pollen grain had germinated and sent out a small pollen tube.

I am not aware if a parallel case has been reported for any other angiosperm, and would be grateful to other botanists for directing my attention to the relevant literature on this subject.

I am deeply indebted to Dr. P. Maheshwari for his kind help and valuable suggestions.

B. M. JOHRI.

Department of Botany,  
Agra College, Agra.  
July 18.

<sup>1</sup> Dahlgren, K. V. O., "Die Embryosackentwicklung von *Echinodorus macrophyllus* und *Sagittaria sagittifolia*", *Pflanzl.*, 21, 602-612; 1934.

<sup>2</sup> Artschwager, E., and Starret, R. C., "The Time Factor in Fertilisation and Embryo Development in the Sugar Beet", *J. Agric. Res.*, 47, 832-43; 1933.

### Functions of the Corpus Allatum of Insects

It was suggested recently<sup>1</sup> that the active substance (moulting hormone) which initiates cell division in the epidermis of *Rhodnius* and so induces moulting, and the substance (inhibitory hormone) which restrains 'metamorphosis' until this insect is full-grown, are both secreted by the corpus allatum. By transplanting the corpus allatum from a younger

insect (4th instar) into an older one (5th instar), which then develops into a nymph instead of an adult, it has since been proved that the absence of metamorphosis in the young stages is certainly dependent on the secretion of this gland; though it is still uncertain whether there are really two hormones or only a single one in different concentrations. Further, both moulting and inhibitory effects are non-specific: both can be produced in *Rhodnius* by appropriate secretions from bugs of the allied genus *Triatoma*.

The corpus allatum remains active in the adult *Rhodnius*; this suggests that in this stage it is concerned in the regulation of reproduction. This has been proved to be the case. Adult females deprived of the brain and corpus allatum do not develop eggs; but if the brain is removed without the corpus allatum, eggs are developed normally; and the blood from females with a corpus allatum will induce egg development in females without. This effect, also, is non-specific.

The moulting hormone will not induce egg-formation; nor will the egg-forming hormone induce moulting. This little gland therefore secretes at least two and possibly three hormones regulating growth. It has already been suggested that diapause in insects may be due to a temporary failure of its secretion<sup>1</sup>; perhaps the so-called 'gonotrophic dissociation' (the failure to develop eggs after feeding), which occurs in the females of certain mosquitoes during hibernation, is due to the same cause. This question is being investigated.

V. B. WIGGLESWORTH.

London School of Hygiene  
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Aug. 3.

<sup>1</sup> V. B. Wigglesworth, *Quart. J. Micr. Sci.*, 77, 191; 1934.

### Plankton Production and the Nitrate Nitrogen and Phosphate Cycles in the Pacific Ocean off New South Wales

RECENT quantitative research into the production of plankton and more especially into the seasonal cycle of plankton production has been accompanied by a keen appreciation of more accurate chemical analyses of sea-water. Whilst the complexity of the interrelationships between the biological and the physico-chemical conditions in the sea are being thoroughly realised, some rather definite and interesting correlations have been already demonstrated, and the investigation of the different seas in different latitudes promises further light on this subject.

One of the most interesting of these correlations is the marked cycle in the amount of nitrate nitrogen and phosphate in European seas, which seems closely bound up with the cycle of plankton production. Thus Harvey and Atkins working at Plymouth have shown how the nitrate nitrogen and phosphate are reduced almost to zero in the surface waters of the English Channel during the summer months, the fall beginning after the attainment of a maximum in the growth of diatoms during the spring.

During the past four years, a continuous series of plankton and physico-chemical determinations have been made by us in the Pacific Ocean off the New South Wales coast on the open continental shelf. The results indicate that whilst there is not such a

marked cycle as in the English Channel (our sea temperatures are much higher, ranging from approximately 16° C. to 22.5° C.) there are definite occasions in the year when the nitrate nitrogen in particular and the phosphate to a slightly lesser extent are reduced to a mere trace in the surface waters, or even to zero. These occasions always occur after the attainment of a spring maximum in diatom production. The summer is a period with a low concentration of nitrate nitrogen, but the phosphate concentration typical of these seas is quickly regenerated. The winter concentration of phosphate in our surface waters ranges from 20 mgm. to 30 mgm. P<sub>2</sub>O<sub>5</sub> per cubic metre, whilst the nitrate nitrogen ranges from 20 mgm. to 35 mgm. per cubic metre.

These are probably the first records from the southern hemisphere of a cycle resembling that of European seas, the only other seasonal records being those from the Antarctic with their own peculiarities.

Full details have been drawn up for publication in the *Journal of the Linnean Society of New South Wales*.

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July 24.

### Ventilation and Domestic Heating

THE "Writer of the Note" on this subject<sup>1</sup> refers to experiments carried out by the Department of Scientific and Industrial Research and the Medical Research Council, and adds that "No evidence was obtained that any difference on 'nose opening' is due to the temperature of the source, either bright or dull". These experiments were carried out by Messrs. Dufton and Bedford, who received grants from the above bodies, which as customary allowed their grantees to publish their researches on their responsibility and not on that of the Department or Council.

I myself have received a grant from the Medical Research Council to aid me in research which negates the conclusions of Dufton and Bedford.

The correctness of my conclusions about 'nose opening' rays has been confirmed not only by myself, but also by Dr. W. A. R. Thomson, who carried out observations on 100 sailors at H.M.S. *Excellent*, and by Dr. Dishoeck of the Rhinological Department, Groningen University. The latter has used an exact method of experiment, and has pointed out the cause of the failure of Dufton and Bedford to confirm my work.

Dr. Dishoeck's paper was published in the June number of the *Journal of Industrial Hygiene*. In the *Lancet*, July 13, 1935, I published the latest of my papers on the subject, and described therein a method of measuring the air-way of the nose, which should prove of general use to rhinologists. There is no doubt of the susceptibility of certain people—not all, but about 50 per cent—to 'nose opening' rays or of the importance to comfort of the quality of the rays imparted by sources of heat.

LEONARD HILL.

<sup>1</sup> NATURE, 136, 225, Aug. 10, 1935.

I HAVE read with interest Sir Leonard Hill's letter and his paper on "A Method of Measuring the Air-way of the Nose" which appeared in the *Lancet* of

July 13. As the subject is of practical importance, I am sorry that experts do not seem to be in agreement as to its extent or as to its effect on the general health of the half of the community which is said to be affected by it. Considerable use by those commercially interested in domestic heating has been made of expert assertions on the subject, and these are widely quoted. It is difficult to find out the magnitude of the effect and whether it is of importance or not in other than pathological cases. Personally, I have never noticed it. Further information on this subject will be welcomed by everyone.

THE WRITER OF THE NOTE.

### Perspiration and Erythema

PRELIMINARY spectroscopic experiments have been made to determine the absorption of ultra-violet light by human perspiration. The results, so far only qualitative, indicate that a film of sweat one millimetre thick absorbs light slightly in the region of 3300 Å., very appreciably at 2900 Å., and is practically opaque at 2700 Å. Since sunburn is induced principally by light of wave-lengths lying between 2900 Å. and 3100 Å., these results indicate that human sweat acts as a partial protection against sunburn to a degree which depends upon the thickness of the layer.

Personal experience rather supports the point of view that sunlight effective in producing erythema is absorbed by perspiration; for, other things being approximately equal, one is usually sunburned more readily on a windy day than on a quiet one. Here the presumption is that the wind keeps the body cool and dry and thus nearly free of perspiration. Better evidence is that of a friend, H. C., who, while canoeing on the Mississippi River with G. P. on a very hot day, frequently dipped his arms into the river, and at the end of the day experienced a severe case of erythema on the arms. On the other hand, G. P., whose arms were likewise exposed to the sun, did not immerse them in the water and suffered merely a modest burn. Both canoeists had commenced the day with a normal summer tan. Assuming the two to have been comparable subjects, one is tempted to the opinion that the frequent immersion of the arms of H. C. kept them free of perspiration, while G. P. enjoyed the protection which the sweat afforded against the actinic rays of the sun.

The constituents of perspiration most likely to be effective in absorbing light in the neighbourhood of 2950 Å. are urea, uric acid and certain amino acids. Urea absorbs light in this spectral region slightly, but is nevertheless present in relatively large amount in human sweat. Uric acid has an absorption band with a maximum at about 2900 Å., but appears only in small amount in normal sweat. The amino acids, tryptophane and tyrosine, if they appear in sweat, may be effective in producing absorption since they each have an absorption band at about 2900 Å.

The fact that normal urine, which contains relatively much more uric acid than does sweat, cuts off rather sharply all light below about 3100 Å., suggests that perhaps uric acid may be the primary absorbing agent in human perspiration.

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Aug. 12.

### The Profession of Management

IN view of the forthcoming meeting of the British Association and the dominant place accorded to management in Section F\* (Department of Industrial Co-operation), a brief explanatory statement of the position of management, as I see it, from a vocational and scientific point of view, may be of interest.

Management, which at the higher levels is the same thing as administration, is tending to become, or made, a 'recognised' profession, comprising (1) practitioners (that is, actual managers); (2) management consultants (corresponding to 'counsel' and 'specialist' in law and medicine); (3) management research workers (corresponding to those in science); (4) educators for (a) imparting instruction about management (and its associated subjects and sciences), (b) training (fitted) people for management, or, if already managers, for promotion or advancement.

It will be apparent from (1) that management is in reality not a subject but a functional activity, the activity of directing, organising, controlling and developing in an almost infinite variety of circumstances. Under (2) two functions are distinguishable: (i) management 'auditing' to improve or strengthen the management of an individual concern (in the case of a 'business' increased profits expected as a result), (ii) management 'auditing' to determine, in the case of a 'business', safety as regards financial investment, or suitability of any concern for investment of individual effort. Under (3) the work is largely method- and technique-invention, statistical inquiry and objective psychological investigation (managerial thinking, attitudes, training and vocational selection and guidance). The distinction under (4) is highly important. Its neglect is responsible for much of the ineffectiveness of some university courses. Education may be regarded as the 'mother' function of the new profession as a whole, but as in other fields, only supplementary or preparatory to learning by practical experience.

Since managerial action (or inaction) is based on human decisions and judgments, 'good' management should always be used in preference to the Continental 'scientific' management. 'Good' implies the maximum application of scientific method without eliminating the all-important factors of wisdom and morality.

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### Experimental Phonetics and Ancient Greek Verse

ANALYSIS of a macrophonic registration<sup>1</sup> of "Devon to Me!" spoken by John Galsworthy<sup>2</sup> showed that 15 of the 40 lines of the poem had a rhythmic form indicated by  $\epsilon \cup \cup \cup \cup$ ; an example is the line "Where my fathers stood". This is the form known in ancient Greek metrics as the hypodochmius (for example, "Oed. rex", 1208). Twenty lines had the form  $\epsilon \cup \cup \cup$ ; an example is "Watching the sea". This is the choriambus, a very common ancient form. Five lines had the form  $\epsilon \cup \cup \cup \cup$  as in "Taste of the cream pan!" This is the form termed adoneus. Every line of the poem was spoken with some form of ancient Greek rhythm. The registration of the first stanza of "Drake's Spirit" by Galsworthy himself showed that the line "I, Francis Drake" had the rhythm of the third epitrite  $\epsilon \cup \cup \cup$  as in "Medea", 628, and that the line "When the land needs"

had the rhythm of the rising ionic  $\cup \cup \cup \cup$  as in "Phoen.", 1539.

A registration of "Hickory, dickory, dock" showed a rhythm of  $\cup \cup \cup \cup \cup \cup$ ; this is a hemiepes as in "Medea", 412. The line "Gems of a master's art" (Bridges, "Buch der Lieder") was spoken with the rhythm  $\cup \cup \cup \cup \cup$ ; this is one form of the dochmius as in "Agamem.", 1166. "Here a little child I stand" (Herrick, "Grace for a Child") registered with the rhythm  $\cup \cup \cup \cup \cup \cup$ ; this is a lektheion as in "Phoen.", 642. "Tell me thou star whose wings of night" (Shelley, "The World's Wanderers") was spoken with the rhythm  $\cup \cup \cup \cup \cup \cup$ ; this is the choriambic dimeter as in "Antig.", 332. "Fear no more the heat of the sun" (Shakespeare, "Cymbeline", 2, 4, 249) had the rhythm  $\cup \cup \cup \cup \cup \cup$ ; this is the choriambic dimeter as in "Antig.", 107. "A wet sheet and a flowing sea" (Cunningham, "A Wet Sheet . . ."), yielded the rhythm  $\cup \cup \cup \cup \cup \cup$ ; this is a form of the glykoneus as in "Iphig. Taur.", 1097. The line "Ein schönes, wohlgewachsenes Buch" (Ginzkey, "Das Buch"), spoken by the poet himself, showed

the rhythm  $\cup \cup \cup \cup \cup \cup$ ; this is the iambic dimeter, a common ancient form. "Die Damen im schönen Kranz" (Schiller, "Der Handschuh"), spoken by a German, registered with the form  $\cup \cup \cup \cup \cup \cup$ ; this is the ancient telesillion.

The lengths of the vowels in ancient Greek verse are known. The examples given here seem to justify the conclusion that, wherever the lengths of the vowels in ancient Greek verse correspond with the lengths in English and German verse as determined by registration and measurement, the rhythmic scheme is the same. Many—perhaps all—the ancient forms may be established on this principle. Greek metrics thus becomes an exact science consisting of numbers obtained by measurements.

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June 28.

E. W. SCRIPTURE.

<sup>1</sup> See NATURE, 132, 138; 1933.

<sup>2</sup> Janvrin, "Analyse von zwei von John Galsworthy gesprochenen Gedichten", *Z. Exper.-Phon.*, 32, 1, 147; 1930.

<sup>3</sup> Scripture, "Anwendung d. graphischen Methode auf Sprache u. Gesang", 73, Leipzig, 1927.

### Points from Foregoing Letters

PROFS. F. A. PANETH and G. P. Thomson state that during the bombardment of heavy hydrogen with positive rays (positively charged hydrogen atoms) they had obtained, like Harnwell, Smyth and Urry, measurable amounts of helium; they consider, however, that this is not helium of mass 3 resulting from atomic transmutation, but helium gas adsorbed on the walls of the glass discharge vessel, and afterwards released by the hydrogen.

The only way to explain satisfactorily the long life period of the radioactivity of potassium, according to Dr. K. Sitte, is to assume the existence of a rare isotope of mass 43, which loses an electron and becomes the calcium isotope of the same atomic mass.

From the transitory changes in the absorption spectrum of the liver enzyme catalase, when monoethyl-hydrogen peroxide is added to it, Dr. K. G. Stern deduces the formation of an intermediate compound. This compound breaks down less rapidly than the intermediate compound presumably formed between catalase and hydrogen peroxide, since in the latter case there is no apparent change in the enzyme spectrum.

Dr. E. E. Jelley has studied the dichroism of some rare-earth salts and has found that bands are missing from the absorption spectrum for certain ray directions and planes of vibration. These ray directions for zero absorption differ from band to band, and are not always coincident with the axes of the Fresnel wave surface. He considers that this is strong evidence that at least some of the electronic orbits of the incomplete *N* shell are fixed with regard to the crystal structure, and that the rare-earth ions as a whole are incapable of free rotation.

The magnetic susceptibilities of single crystals of thallium metal parallel and perpendicular to the hexagonal axis, and their variation with temperature as the crystal changes to cubic symmetry, have been investigated by Prof. S. R. Rao and K. C. Subramaniam. The authors consider that the hexagonal

structure is due to the three valency electrons of thallium, while in the cubic structure only the single valency electron is active.

The elastic constants of glass have been calculated by Dr. E. Hiedemann from measurements of the velocity of short (ultra-sonic) compression waves. Observations were made with crossed nicols upon the nodal lines produced in a cube of glass by the transverse waves which bring about double refraction at the position of maximal elastic strain.

An additional wave produced by earthquakes, due to reflection first at the earth's surface and then at the boundary of the earth's core, has been identified at the Dominion Observatory, Wellington. This provides, as R. C. Hayes points out, a method of locating abnormally deep earthquakes from a single record near the epicentre.

Dr. V. B. Wigglesworth has shown that in the blood-sucking bug, *Rhodnius prolixus*, the corpus allatum secretes the active substance which prevents the appearance of adult characters ('metamorphosis') until this insect is full-grown; and also, in the mature female, a substance which causes development of the eggs.

The amount of nitrates and phosphates in the surface waters of the Pacific Ocean off the coast of New South Wales is reduced to a mere trace after the attainment of a maximum in diatom production (for example, in spring), according to Prof. W. J. Dakin and A. N. Colefax; this phenomenon is similar to that observed by Harvey and Atkins in the English Channel.

Experience suggests that one is not so likely to receive severe sunburn when the skin is covered with a thick layer of perspiration. Prof. W. H. Crew has made qualitative spectroscopic observations which show that perspiration absorbs, to a considerable extent, the erythema-producing rays of sunlight. The small amount of uric acid in human sweat may be the principal agent in causing this absorption.

## Research Items

### Early Bronze

PROF. CECIL DESCH points out the difficulties in determining the sources of ancient tin and copper in a discussion of the origin of bronze (*Trans. Newcomen Soc.*, 14, 1933-34). The term 'bronze' was applied loosely by archaeologists to objects which on examination have proved to be copper. Many have supposed that the bronze age was preceded by a copper age, sometimes regarded as of a considerable duration; that the introduction of bronze was accidental; and that a composition of 90 to 10 was arrived at experimentally. This was probable only if native copper was first used and hardened by hammering, casting being discovered later. It is now known that true bronzes are found at a very early date together with copper. The presence of certain 'key' elements, such as nickel and arsenic, affords a clue to the origin of the copper ores. Of two specimens of native copper from Angora and Arghana, the latter was only 97.08 pure, the remainder being tin, iron, nickel and sulphur. On the other hand, the purity of certain ancient objects does not prove the use of native copper. Probably they were obtained by smelting a pure malachite ore. Early Mesopotamian objects are usually free from sulphur, which points to the use of oxidised copper ores. Nickel in early Mesopotamian objects has led to a search for ores containing nickel, and the tentative identification of the Magan of Sargon of Agade as a possible source in Oman. Recently, the presence of arsenic in certain objects has turned attention to Anatolia, Armenia and Caucasia generally. Zanghezour in Azerbaijan is mentioned as the source of Persian and Median copper, and the copper obtained here at the present day shows small quantities of nickel and arsenic. No metallic tin has been found before the eighteenth dynasty. There are few records of its occurrence in those areas of Asia with which the ancient Sumerians were concerned. Importation from Britain or Spain cannot be assumed. Bronze must have originated in the East, but the problem of its origin is unsolved.

### Mud-Castle of the Han Dynasty, Chôsen

FOR some twenty years, Japanese archaeologists have been engaged in exploring tombs of the Han Dynasty in Chôsen, one of the four provinces instituted by the Emperor Wu-ti in 108 B.C.; but in April 1935 investigation was extended to the 'dojô' (mud-castle), of which indications had been found. According to a report of the excavator, Yoshito Harada (*Proc. Imp. Acad.*, Tokyo, 11, 6), "discoveries of supreme value and importance" have already been made. The ruins of the dojô lie some 6 km. from Heijô in the midst of a tract studded with tombs of the Lo-lang period. The remains of mud walls, tiles and other objects in an area 0.8 km. square, now devoted to farms, pointed to the former existence there of buildings. Excavation brought to light a foot-way, 38 m. long by 8 m. broad. It was paved with tiles, but with marble at the margins. Remains of buildings, 10 m. by 8 m. in area, were excavated. On one wall was found a Korean heater of brick, with a chimney of stone and brick still

standing. Among the objects found were a bronze tripod vessel, iron arrowheads, coins, crystal and glass beads, pottery, tiles, etc. The most valuable find, however, consisted of two clay sealings bearing impressions of the seals of Government officials of the districts of T'i-hsi and Pu-êrh respectively. Chinese historical records mention the former in both the earlier and later Han periods, but the latter was in existence only in the earlier. This sealing, therefore, serves to fix the date of the building as certainly not later than A.D. 25. This is the first example of Han architecture to be discovered. The purpose of the building is at present uncertain; but the great number of tiles bearing the inscription "Lo-lang-li-kuan" which have been found suggest that it was the Government office in charge of ceremony. Excavation is to be resumed in the autumn.

### Researches on *Calanus finmarchicus*

A CONTINUATION of the important team work on plankton at the Millport Marine Laboratory by Drs. S. M. Marshall, A. G. Nicholls and A. P. Orr which has now been going on for some years has recently been published (*J. Mar. Biol. Lab.*, May 1934, Feb. 1935). "On the Biology of *Calanus finmarchicus*. Part 4. Seasonal Changes in the Weight and Chemical Composition in Loch Fyne. By A. P. Orr. Part 5. Seasonal Distribution and Size, Weight and Chemical Composition in Loch Striven in 1933, and their Relation to the Phytoplankton. Part 6. Oxygen Consumption in Relation to Environmental Conditions. By S. M. Marshall, A. G. Nicholls and A. P. Orr. Following the previous work on size and distribution (Pts. 1 and 2), an attempt was made to ascertain what changes of weight and chemical composition took place throughout the year. It was found that Stage V accounted for much the most important part of the total weight of the catch, and it is usually largest and heaviest when most abundant. Although smaller than the female *Calanus*, Stage V was from the beginning of June to the end of August considerably heavier; its weight fell during the spring and did not increase again until after the end of the first breeding period. In Loch Striven there were three main breeding periods, in February and March, May to June, and in July, with subsidiary broods in August and September. The first brood, which developed when the sea was at its coldest, consisted of *Calanus* of the largest size found during the year; after this there was a gradual fall, corresponding with the warming of the sea. Diatom increases corresponded with the three main spawning periods giving plenty of food for the nauplii. Experiments were made in order to determine the oxygen utilisation by male, female and Stage V. From the amount of oxygen used in respiration, calculations of the food required are made and these are compared with the results given by Pütter for *Calanus* and other copepods. The figures indicate that for Stage V (the most abundant form) and for the adults which require more, the amount of food required daily is very much lower than that calculated by Pütter for *Calanus*.

## Crustacea from Polynesia

MR. CHARLES HOWARD EDMONDSON records some very interesting new species in his paper "New and Rare Polynesian Crustacea" (Bernice P. Bishop Museum Occasional Papers, 10, No. 24, 1935). *Mesocaris lauensis* is a new species for which a new genus is created in the Atyidae. This was taken in a cave containing brackish water on the Island of Namaka and from a salty lake on the Island of Wangana in the southern Lau Islands, Fiji. It represents a very primitive type of Atyd with well-developed exopodites on all the legs and presenting other characters warranting a new genus, but is fairly closely related to *Xiphicaris Paratyta* and *Palæmonias*, all of which have exopodites on all the legs, *Paratyta* being the only one of these which has penetrated in any degree into the south-west Pacific area. The number of gills is identical in this genus and *Mesocaris*, epipodites being present on the third maxillipedes and all the legs but the last, and in the present species these are peculiarly shaped with a strong terminal hook and a constriction near the free end. Besides these there are seven pairs of gills. The eye pigment is considerably reduced both in the cave specimens and in those of the same species from the brackish-water lake, which is quite exposed. The lake is, however, connected with the sea by subterranean channels, and it is probable that underground caverns and passages connected with the lake have for a long period of time offered habitats encouraging adaptation to a cavernicolous existence. Among the many new finds, a Xanthid crab belonging to a new genus *Nullicrinus*, having atrophied antennae, is described from Christmas Island.

## Insects of Samoa

PART 9, Fasc. 2, pp. 33-104 of "Insects of Samoa", in course of publication by the British Museum (Natural History), consists of a summary by Prof. P. A. Buxton, dealing with the evidence that may be derived from a study of the insect fauna of these islands. While the collection of Samoan insects is far from complete, it forms a basis from which general conclusions may be drawn. Out of the 1,603 species of insects known to occur in Samoa, 49 per cent appear to be endemic. This percentage of endemism is notably lower than that which obtains, for example, in the Hawaiian Islands and the Seychelles. The study of the insects, both of those which are absent and those which are present, leads to the same conclusion, namely, that the Samoan fauna is oceanic. There are, however, certain species of insects of specialised habits the occurrence of which is difficult to reconcile with this conclusion. It is clear, and generally admitted, that the fauna of Samoa is essentially Indo-Malayan, but one or two characteristic Australian groups have reached the islands, apparently by natural means. The problem as to how the existing forms of life, or their ancestors, crossed the ocean from Indo-Malaya is a difficult subject. Such questions have long puzzled zoo-geographers and, although we are not yet in a position to answer them, knowledge is advancing in certain particulars. The great stream of anti-trade wind, at no great altitude, may well carry insects and other forms of life eastwards. Recent work on insects found in the upper air suggests that air currents are a much more important factor in distributing small insects than has been realised. Also, the wanderings of oceanic peoples before the advent of the European may have had a

considerable influence on the distribution of both plants and insects. In connexion with the transport of insects by means of the traditional floating logs, Prof. Buxton suggests that a study is needed of the effects of sea-water on all stages of insects which have a wide distribution among tropical islands.

## The Rhododendron White Fly

THE common white fly of greenhouses is now a well-known plant parasite, but it has other near relations which appear to be equally destructive. Mr. G. Fox Wilson has described one of these (*J. Roy. Hort. Soc.*, 60, Part 6, pp. 264-271, June, 1935). The rhododendron white fly, *Dialeurodes chittendeni*, first appeared in 1926 and is now reported from numerous stations in the south of England. The account under review describes the various stages of the insect, and outlines its life-history. Damage to the host is illustrated by means of very clear photographs. Control may be effected by spraying the lower surfaces of infected rhododendron leaves with a white oil and nicotine emulsion. The Chalcid wasp, *Encarsia formosa*, which parasitises the greenhouse white fly, also attacks its relative on the rhododendron, but low night temperatures and the rather long life-cycle of the parasite militate against its successful use as a control measure.

## Experiments on Plant Virus Diseases

THREE papers on various aspects of plant virus diseases by Dr. J. Caldwell, Rothamsted Experimental Station, have recently appeared. "The Control of Virus Diseases of the Tomato" (*J. Minis. Agric.*, 41, 743-749, Nov. 1934) recommends the removal of weeds, avoidance of smoking tobacco (which transmits tobacco mosaic), the early removal of infected plants, and routine fumigation to keep down insect vectors. "Experiments on the Purification of the Virus of Yellow Mosaic of Tomato" (*Ann. App. Biol.*, 22, 68-85, Feb. 1935) discusses various methods of purification, and shows that there is no evidence that virus can be recovered in a crystalline form; infectious material always contained organic nitrogen. The virus was found to be active between pH 2.0 and 10.5. A paper "On the Interactions of two Strains of a Plant Virus; Experiments on Induced Immunity in Plants" (*Proc. Roy. Soc.*, B, 117, 120-139, March 1935) shows that two strains of yellow mosaic virus can be isolated. These are apparently quite distinct as regards characters *in vitro*, and it is suggested that many anomalies in symptom expression of this and other virus diseases can be explained by assuming the presence of strains in the causal agent. A virus strain may inhibit the development of another strain in the same host; the two strains may multiply separately and independently; the second virus may multiply without causing symptoms, or it may add to the severity of the disease produced by the first strain.

## Cowpea Rust

A RATHER serious fungus disease of the cowpea (*Vigna sinensis*) reduces the yield of this crop in Egypt. It has been known since 1919, but a full study of its life-history has recently appeared by Dr. Tewfik Fahmy (*Min. Agric. Egypt. Bull.* No. 144, Publications Office, Govt. Press, Bulâq, Cairo, 1935. P.T. 5). The cause of the disease is a rust fungus, *Uromyces vignae*, and produces uredospores,

teleutospores, spermatia and aecidia upon the cowpea. The ten pages of the bulletin are devoted to descriptions of the fungus and its symptoms, with proof of its pathogenicity. Spermatia and aecidia appear during July and August, being quickly followed by uredo and teleuto stages, as the temperature gets cooler and the humidity increases. Twelve half-tone illustrations portray the symptoms and the causal fungus, and a further bulletin, on the selection of varieties of cowpea immune to the disease, is promised.

#### Kinetics of Photosynthesis

In a recent theoretical paper, Prof. E. C. C. Baly (*Proc. Roy. Soc.*, B, 117; 1935) has derived equations to express the known variations in the rate of photosynthesis in varying conditions. The treatment is based on the supposition that the photosynthetic process consists of three distinct stages: (a) the union of chlorophyll *a* with hydrated carbon dioxide; (b) an oxidation-reduction reaction in which the chlorophyll *a*-carbonic acid complex is converted photochemically to chlorophyll *b* and activated formaldehyde; (c) the Blackman reaction in which, it is suggested, chlorophyll *b* is reduced by carotin to chlorophyll *a*, and xanthophyll is produced. The condition in which the velocity of oxidation of chlorophyll *a* to chlorophyll *b* in the light reaction is equal to the velocity of its regeneration by the Blackman reaction is described as a "photostationary state". It is this condition which is defined by the equations, which are shown to express with noteworthy accuracy the variation in rate of photosynthesis with temperature, the theoretical curves agreeing well with Emerson's data on *Chlorella*. These equations are extended to express the influence of varying total light intensity, carbon dioxide concentration, intermittent illumination and the effect of poisons. Prof. Baly's view that the primary photosynthetic reaction consists of two consecutive light reactions, stimulated by blue and red light, is expressed by equations modified in this respect, and data calculated from these equations agree well with the observations of Briggs and Warburg on the effects of varying the relative intensities of red and blue light. Baly's formulation of the Blackman and light reactions will not be received without criticism, but if it is admissible as a basis for hypothesis, the subsequent mathematical treatment will form an interesting addition to the theory of photosynthesis.

#### Eocene Foraminifera

In a memoir on the Upper Eocene Foraminifera of the south-eastern United States (U.S. Geol. Surv., Prof. Paper 181; 1935), J. A. Cushman describes 203 species or varieties from the Jackson formation. The sediments are variable in character, some being of very shallow water nature, others much deeper. The foraminiferal faunas show differences corresponding with differences in the depth of the deposits. The shallow water type resembles the fauna of the shallow water in the Indo-Pacific region rather than the living fauna of the West Indies. On the other hand, the deeper water fauna is much more closely allied to the fauna still living in the Gulf of Mexico and the West Indian region. T. W. Vaughan and others have already pointed out the resemblances of the early Tertiary corals, etc., of the West Indies to genera now living in the Indo-Pacific region.

#### Sound Insulation

THE issue of the *Journal of Research of the Bureau of Standards* of June contains Research Paper 800 on "Recent Sound Transmission Measurements at the Bureau of Standards" by Messrs. V. L. Chrisher and W. F. Snyder. The source of sound is a loud-speaker mounted on a rotating arm so that it describes a circle 5 feet in diameter. It can emit nine frequency bands between 128 and 4096 cycles per second, each band of width 20 per cent of its middle frequency. The chamber in which the sound is produced has walls 6 inches thick of reinforced concrete and is about 10 ft. × 12 ft. × 12 ft. It is insulated by 3 inches of air from a chamber by its side and another above it, and the panels to be tested can be inserted in the wall or ceiling. Measurements of sound pressure are made by means of a microphone placed in turn on each side of the panel under test and at different distances from its centre along its normal. Detailed results are given for 28 panels tested, and confirm the laws that a solid homogeneous wall must be very heavy to be a sound insulator, and that dividing it into layers as loosely connected as possible increases greatly its sound insulating properties.

#### Transport Numbers of Salts

THE older measurements of transport numbers by the so-called moving boundary method were subject to considerable doubt, and the utility of the method had been questioned. A series of careful measurements with the use of improved apparatus made by MacInnes and others showed that the method is capable of giving very satisfactory results, and it has been used to determine the transport numbers of several salts. On the simple ionic theory, the transport number is regarded as constant; but it is now known to depend on concentration, so that a comparison of conductivities at different concentrations does not give the degree of ionisation without further correction. The mobilities of individual ions as functions of concentration may be obtained by combining transport numbers with conductivities, and accurate values of activity coefficients may be obtained from transport data and electromotive force measurements with certain cells with liquid junctions. Some further measurements of transport numbers by the moving boundary method, and a useful summary of previous results, are given by L. G. Longworth (*J. Amer. Chem. Soc.*, 57, 1185; 1935). The paper contains tables for the transport numbers of several salts in aqueous solutions at 25° at various concentrations. Two types of boundaries are distinguished, namely, autogenic boundaries, formed automatically by the electrochemical solution of an appropriate metal anode, and sheared boundaries, made by the superposition of leading and indicator solutions. The latter involves a special mechanism, first described by MacInnes and Brighton, by means of which one solution is superposed on another with a minimum of disturbance to either solution. Although the moving boundary method may be used over a wide range of concentration if the proper indicators are available, it is most useful in the interval 0.01-0.2 *N*. Outside this range, sources of error become important. Solvent and volume corrections must be applied, the first for the conductance of the solvent and the second for the changes in volume of solution by transfer of electrolyte. Recent measurements by the Hittorf and moving boundary methods are in agreement.



# An Apparatus for Rearing Marine Organisms in the Laboratory

By Dr. F. G. Walton Smith (Commonwealth Research Fellow)

ALTHOUGH the life-histories of the most important marine organisms have been worked out in the past, there is very little known in many cases regarding the detailed changes that take place during the critical stages separating larval life from that of the adult, while the study of the physiology of invertebrate larvæ has been almost entirely neglected.

These gaps in our knowledge are partly due to the minute size of many of the larvæ, but also in large measure to the difficulty experienced in rearing them in the laboratory. Even though the most scrupulous care be taken in sterilising instruments and vessels, and in keeping physical and chemical conditions of the environment 'normal', this difficulty remains; and it is a common experience to find that larvæ will live in plunger jars for days and weeks longer than the natural period of their free-swimming existence without increasing in size or developing organs characteristic of the metamorphosing stages. On the other hand, attempts to provide food in the form of organisms isolated from the microplankton, though occasionally successful, are usually doomed to failure, owing to the ease with which the physical, chemical and biological factors of the environment in a restricted volume of water pass beyond our control, and to our ignorance of the actual food requirements.

If, however, a continuous flow of fresh sea-water can be supplied to the organisms in sufficient quantity, not only will physical and chemical conditions remain stable, but also food organisms of the kind available under natural conditions will be provided, and in sufficient concentration to permit of normal growth and development. It was found necessary recently, in order to study the metamorphosis and biology of the larval oyster, to construct an apparatus that would satisfy this requirement, and make it possible to undertake the rearing of all stages in development with a high degree of certainty. The apparatus (Fig. 1) and procedure described below have given consistently satisfactory results, not only with the larvæ of the common American oyster, but also with later stages of *Ostrea equestris*, and species of *Chiton*, *Crepidula* and *Fissurella*.

The type of vessel employed is the cylindrical jar used in some fish hatcheries, and is about 18 in. high and 6 in. in diameter, with a conical base (*B*). This shape has the advantage that on stopping the flow of water the larvæ quickly settle to the bottom and are readily collected. In order that the flow of water may not carry away the small larvæ (early stages of *Ostrea virginica* are less than 0.06 mm. in smallest dimension), the outflowing water is removed from the rearing jar by means of a siphon (*S*<sub>3</sub>), the wide mouth of which (*F*<sub>2</sub>) is covered by a fine net of bolting silk. Rapid clogging of the pores of this material is prevented by dipping the mouth of the siphon under the surface of molten paraffin wax melting at a temperature of 48° C. and then blowing air through the other end as it is removed. The resulting smooth coating of wax on the fibres of the net seems to prevent the entanglement of the

larvæ, and allows the filter to work efficiently for a much longer period than otherwise would be the case. The net is fitted to the siphon by means of a rubber band.

The sea-water supply is taken from the reservoir feeding the main laboratory circulation, replenished by pumping from the sea once or twice a week. Where there is no such source of supply, it is necessary to use a supply tank which is replenished when needful with sea-water taken at high tide.

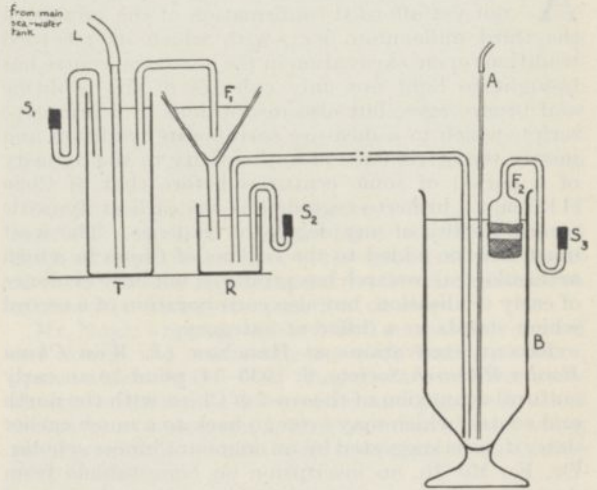


FIG. 1.

Whereas the exit siphon is placed at the top of the jar, the sea-water enters the vessel through a glass tube extending to the bottom of it, thus making a good circulation of water possible. It is important that the sea-water supply should also be filtered, and to the same extent as the outflow, in order to guard against the accumulation of detritus and the admission of predatory organisms. This is conveniently carried out by means of a square piece of bolting silk supported in a filter funnel (*F*<sub>1</sub>). Aeration and circulation of the sea-water in the jar are accomplished by means of a glass tube (*A*) connected with a compressed air supply and extending to the base of the jar.

In order to prevent the sea-water from entering the jar faster than it is removed, with subsequent loss of the larvæ, and in order to prevent an overflow from the filter funnel, a constant level siphon (*S*<sub>2</sub>) is attached to the reservoir (*R*) supplying the rearing jar, and a similar arrangement is fitted to a vessel (*T*) feeding the filter. The constant-level siphons may be adjusted by means of small pieces of rubber tubing on the outer arms. The rate of flow of the sea-water through the rearing jar is regulated in this way, and is dependent upon the vertical distance between the outflow of siphons *S*<sub>2</sub> and *S*<sub>3</sub>.

The use of this apparatus is not confined to the rearing of organisms alone. A series of rearing jars may be connected to the same supply reservoir, and if eggs from a single artificial fertilisation are distributed among them in equal numbers, they will

be able to develop under exactly similar conditions, providing a basis from which biological and physico-chemical conditions may be varied for experimental purposes. In order to analyse food requirements, for example, jars to which food organisms and solutions of different kinds are added, and which are supplied with sea-water filtered through a porcelain candle filter, may be set up for comparison with the arrangement previously described.

This apparatus has been found to give a sufficient approximation to 'normal' conditions to enable larvæ to be reared through the most critical stages of development, while in use at the Beaufort, N.C., station of the U.S. Bureau of Fisheries, this summer. My acknowledgments are due to the Bureau and to Dr. Herbert F. Prytherch, director of the Station, for hospitality and advice accorded to me during the time when I was making use of it there.

## Archæological Research in Western China

ALTHOUGH archæological research in China has not yet afforded confirmation of the annals of the third millennium B.C., with which its recorded traditions open, excavation in the north and centre has brought to light not only cultures of the neolithic and bronze ages, but also inscriptions in a primitive script, which in a measure corroborate tradition and justify the attribution of authenticity to the dynasty of a period of some centuries before that of Cheo (1122 B.C.), hitherto regarded as the earliest dynastic record worthy of any degree of credence. The west must now be added to the regions of China in which archæological research has produced not only evidence of early civilisation, but also corroboration of a record which stands in a different category.

Recent excavations at Hanchow (*J. West China Border Research Society*, 6, 1933-34) point to an early cultural connexion of the west of China with the north and centre, which may even go back to a much earlier date, if, as is suggested by an eminent Chinese scholar, Dr. Ko Mo Jo, an inscription on bone tablets from Anyang, which records the appearance of men of Shuh in the fighting ranks, and belongs to the Yin dynasty (1400-1122 B.C.), may be taken to refer to Szechwan, of which the ancient name is Shuh. For the fortunate result by which this important addition has been made to knowledge of the prehistoric cultures of China, archæology is indebted to members of the West China Border Research Society, and more especially to Dr. David Graham, curator of the West China Union University Museums, who intervened at a crucial moment to guide the zeal of the Chinese authorities for excavation into channels which would ensure the scientific value of the investigation.

The excavation at Hanchow is one only of a number of activities in which the West China Border Research Society, which was founded in 1922, acting in close co-operation with the Union University, is promoting the advancement of scientific research in the extremely interesting and important border area of western China and eastern Tibet. Its headquarters at Chengtu serve as a focusing point for activities in geographical exploration and studies in anthropology, botany, zoology and medical science, which carry on the scientific work of members of the missionary bodies, who promoted the West China Union University. By their own researches and by their co-operation with members of other scientific expeditions, they did much to promote scientific knowledge of this region long before the University came into being in 1910. The University Museums, which now have 53,334 specimens, distributed among the three Museums of Archæology, Art and Ethnology,

the Natural History Museum and the Museum of Medical and Dental Sciences, owe much to their efforts, especially in the ethnographical section, which contains material such as cannot be found in any other museum. The Society's journal, now in its sixth volume, contains much valuable matter, especially worthy of regard in the anthropological world, as the Society, both in its publications and in the organisation of research among its members, is bound in the terms of its constitution to concentrate on regional and other investigations which bear on problems relating to the little-known non-Chinese peoples of the area.

As regards the excavations at Hanchow referred to above, the accidental discovery in 1931 of stone and jade rings, knives, discs and other objects in a pit at T'ai-p'ing-ch'ang, eighteen li from Hanchow, when an irrigation ditch was being deepened, pointed to the possibility of a prehistoric burial, which was confirmed by systematic excavation in 1934. In addition to the original pit, the ground immediately surrounding was carefully explored and several points in the area were also tested. No further grave pits were found, but everywhere there was abundant material which appeared to be mainly the refuse from a group of ancient pottery kilns.

The preliminary account of the excavation includes also an analysis of the physical characters of the jade and stone objects by Prof. D. S. Pye and of the pottery by Prof. H. B. Collier. A comparison of the culture with that found at Yang Shao and Anyang in Honan and that from Sha Kuo T'un in Fengtien points to interesting resemblances as well as differences. Thus there is no painted pottery at Hanchow or Sha Kuo T'un such as was found by Dr. J. G. Andersson at Yang Shao. Both the Hanchow and the Yang Shao cultures have large and small stone axes, chisels, knives, pestles or hammers, and flat discs, and both incised and cord-marked pottery. In both the potter's wheel is known. At neither, nor at Sha Kuo T'un, is there metal; whereas at Anyang there is abundant bronze, associated with a primitive writing on bone, bone implements and painted pottery.

Though Yang Shao and Sha Kuo T'un are classed as neolithic, the use of the wire saw at Hanchow and resemblances to Cheo objects suggest that the Hanchow site is later than æneolithic. In all probability it cannot be later than the beginning of the Cheo dynasty (1122 B.C.); but it is almost certainly later than the bronze culture of Anyang, which belongs to the Yin dynasty (1400-1122 B.C.). Thus it must represent a retarded development of the west.

## Veneer and Plywood

FOR veneers and plywood, some of the hard tropical timbers, often showing beautiful colouring and figuring, are becoming better known. Research on wood for veneer and plywood has been carried out for some time at the Research Institute at Dehra Dun. In *Indian Forest Records* (Economy Series, 20, 14. Delhi: Manager of Publications, Dec. 1934), Mr. W. Nagle, who is in charge of the Woodworking Section, discusses the "Testing of Indian Timbers for Veneer and Plywood". The purpose of the monograph is "to assist, as far as possible, the advancement of the plywood industry in India, and to further the use of indigenous timbers for veneer and plywood work".

Only those who have followed the development in the use of plywood during the last two decades will have a conception of the variety of purposes to which it is put at the present day. The author reminds the reader that the art of veneering was practised by, and certain forms of laminated construction were used by, the ancient Egyptians. But in Great Britain and for many centuries in Europe, solid wood was used both in house construction and for furniture. Modern demands for luxury articles at a cheap price have assisted and encouraged the use of plywood; but it would be misleading to think that the great demand for this material has been the result of any consideration for the conservation of valuable timbers. The truth is that at the present day every country which possesses areas of forest containing valuable, that is, luxury timbers is, by means of research work and otherwise, endeavouring to place them on the world markets.

It is well known that plywood has come into use in the manufacture of furniture and panelling. But it is worthy of placing on record the following list of other articles which are nowadays formed or built out of this fabricated material: cabin trunks, suit cases, perambulators, and even musical instruments such as violins and mandolins are made of either veneer or plywood. The modern motor-car has considerable amounts of plywood in its make-up, for example, floor boards, hood-stays, body-work, roofing and panelling. Other plywood or veneered articles in common use are chairs, theatre seats, wall panelling and ceilings, screen scenery and stage buildings for the cinema industry and theatres, railway carriages, dining saloons and 'sleepers'. The modern ship is fitted with plywood tables, bulkheads and general appointments. Parts of motor-boats, canoes and life-boats are often constructed of the same material; also aeroplanes and airships. Finally, chests are now made for tea, opium, cement, rubber, etc.; as also fruit and cigarette boxes.

It will be obvious that the above list is capable of indefinite extension. That it has reached its present dimensions gives evidence of the considerable amount of research and experimental work which has been carried out during the past few decades.

Mr. Nagle's monograph is based on research carried out during the past ten years with Indian timbers, upon which little was known as to their suitability or otherwise for veneers and plywood. It is technical in character, with a number of interesting photographs, and deals with some forty-two Indian timber trees.

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## Genetics of Size and Form Factors

THE problems of size and form inheritance are more difficult than many other problems in genetics, partly because the character units cannot usually be directly observed; they are often represented by multiple factors in the germ plasm, and they are also obscured by fluctuations.

Messrs. Sinnott and Dunn (*Biol. Reviews*, 10, No. 2) have summarised our knowledge of the effects of genes on the development of size and form in plants and animals. Their summary is particularly useful because they emphasise the developmental and physiological aspects of size inheritance, although making it clear that fixed genic differences are involved. They point out that some dwarf types both in plants and animals are due to single factors, while many other size differences are due to several multiple factors. The differences may be in cell size, as in some of the polyploid and trisomic forms, or in cell number, or to both acting together. Size genes may depend upon general developmental differences controlled by particular metabolic rates.

In races of large rabbits the rate of cell division very early shows itself to be more rapid, and there is evidence that such races have a higher concentra-

tion of sulphhydryl. Differences in fruit size in tomato varieties are due to differences both in cell number and cell size. Up till the time the flower opens, all the tissues of the ovary are meristematic. Subsequent growth is due to increase in size of the cells. In large-fruited varieties the ovary is larger, but cell enlargement is also carried much further. There appears to be a particular schedule or pattern of growth, involving both cell size and cell number, in each variety. The study of the inheritance of size of parts or organs involves heterogonic growth and Goldschmidt's physiological theory of heredity.

The conception of genic balance is involved, as in the trisomic *Daturas*, where the genes in one chromosome increase and those in another decrease the size of the pith, while other chromosomes affect the relative amounts of xylem and phloem. Thus while size genes may be general in their action, they may also have a special influence on certain parts. As shown by studies of inheritance of fruit shape in *Cucurbita* and the combs of fowls, as well as the proportions between various bones, it is evident that shape factors usually affect not single dimensions but two or three dimensions, through differences in growth rate.

## Science News a Century Ago

### Submarine Navigation Experiments

*The Times* on September 1, 1835, said: "According to the Paris papers, some curious experiments have lately been made at St. Ouen near Paris, with a submarine vessel, the invention of M. Villeroi, the engineer. The vessel is of iron, and of the same shape as a fish of the cretaceous tribe. Its movements and evolutions are performed by three or four men, who are inside, and who have no communication with the surface of the water, or the external air. With this machine navigation can be effected in spite of currents; any operations may be carried on under water, and it may be brought to the surface at will, like an ordinary vessel. It was with a machine similar to this that the project was formed in 1821 for getting away Napoleon from St. Helena. The Société Générale des Naufrages (protector, the King) has appointed Admiral Sir Sidney Smith, Count Godde de Liancourt, the Baron de St. Denis and Dr. Daniel St. Antoine to report on the experiments to be made at St. Ouen."

### Ireland and the British Association

THOUGH the British Association meeting in Dublin in August 1835 was generally regarded as a success, some adverse comments on it were made in the *Dublin University Magazine*, extracts from which were published in *The Times* on September 4. "We cannot conceal our conviction," the *Magazine* said, "that for the purposes of the advancement of science the association is little better than useless. . . . The association, we prophesy, will soon see its end. . . . We rejoice, however, that it has lived long enough to visit Ireland; we rejoice that its visit to this island has been marked by so many traits that confer honour upon our country and our countrymen. We rejoice in anything that can confer honour upon 'ould Ireland', and so having said enough, perhaps some will think too much, upon a subject which we could not pass over in silence, we will leave the 'savans' and the association to go their ways in peace, and we will return with a good heart and an honest purpose to our own labours—labours that, though we may say it 'that should not say it' will do more than 50,000 British Associations to make that same 'ould Ireland'

'What she ought to be—great, glorious and free,  
First flower of the earth, and first gem of the sea'."

### Lyell in Switzerland

ON September 6, 1835, Lyell wrote to Viscount Cole (afterwards Earl of Enniskillen) from Meiringen, giving an account of the work he had done in Switzerland just before he left to attend the meeting of the German naturalists at Bonn. He had visited Berne, made excursions to Neuchâtel and the Jura and had taken soundings in the Lake of Thun. "But I found," he wrote, "when I attempted to understand the geology of the neighbourhood of the lake of Thun, even with Studer's newly published book and map and sections as he calls them in my hand, that I could not at all comprehend it, nor make out what he meant by his numerous formations. I therefore determined to make myself master if possible of the geology of this part of Switzerland, on which much more has now been written than on any other part of the Alps, before I make an attack on less known

districts. This I have in some measure accomplished; but in doing it and climbing the Jungfrau and the Urbach Sattel, I have spent the time which was to have been given to Glaris which I hope, however, is postponed. I must now proceed at once on my way to the Bonn meeting. . . ."

### One of Faraday's Mistakes

FARADAY'S entry in his "Diary", on September 6, 1835, opens with the paragraph: "Rose tells me that Berzelius in his annual account objects to my antimony proto sulphuret, and I am therefore hastened to its examination the first thing this autumn, having meant to defer it awhile before Rose told me this."

The supposed new compound had been referred to by Faraday in his "Seventh Series of Experimental Researches in Electricity", published in 1834, and described as having been prepared by fusing together the "ordinary sulphuret of antimony" with metallic antimony. He now, in September 1835, repeated the fusion more carefully, and analysed the product. The result differed from that previously obtained, for on September 12 the entry appears: "My former conclusions appear to be wrong, whatever the cause of this difference may be". He thereupon wrote off to the *Philosophical Magazine* withdrawing the new compound, saying that Prof. Rose on a visit to London had told him of Berzelius's objections, and that he had been "induced to make more accurate experiments on that point, which showed me my error". The letter, with a translation of Berzelius's paper, was duly published in June 1836.

## Societies and Academies

### PARIS

Academy of Sciences, July 8 (*C.R.*, 201, 105-180). RICHARD FOSSE, PAUL EMILE THOMAS and PAUL DE GRAEVE: The estimation by weight and the identification by elementary analysis of small quantities of formol in very dilute solutions. The method is based on the reaction of formol with  $\beta$ -naphthol, and determines formol at concentrations between 30 and 200 parts per million, with an accuracy of one per cent or less. HENRI DEVAUX: The insolubility of thin plates of albumen. H. GRUYELLE and CHARLES POISSON: The magnetic anomaly of Tsiafajavona. MARC KRASNER: The theory of the ramification of ideals. H. AUERBACH and S. ULAM: The number of generators of a semi-simple group. PAUL MONTEL: Positive harmonic functions. OCTAVE ONICESCU: Holotope functions. ANDRÉ AURIC: An empirical formula giving the distances at which the successive rings of the nebular hypothesis are formed. Mlle. MARGUERITE ROUMENS: The systematic inclination to the west of the equatorial solar prominences of mean latitudes. DANIEL BARBIER, DANIEL CHALONGE and ETIENNE VASSY: The continuous spectrum of Nova Herculis. DIKRAN G. DERVICHIAN: The interpretation of the Eötvös constant and of its different values. NICOLAS STOYKO and RAYMOND JOUAUST: The propagation of short radio-electric waves in the region of the polar aurora. LOUIS NÉEL: The number electrons which contribute to the paramagnetism of nickel. The study of nickel alloys shows that an electron of the alloy metal annuls the magnetic contribution of a nickel electron. There is complete continuity between ferro- and para-magnetism, and

the same electrons intervene in both cases. LÉON and EUGÈNE BLOCH: The spectra of zinc, cadmium and mercury in the extreme ultra-violet. GEORGES DÉCHÈNE: The influence of the passage of an electric current on the phosphorescence of zinc sulphide. MAURICE CURIE: The hyperbolic law of the decline of phosphorescence. MAURICE PROST: The radiation accompanying the dehydration of quinine sulphate. The ease with which the radiation can be deflected shows that it is not due to large ions, thus differentiating this emission from that arising from the oxidation of phosphorus. HENRI MOUREU and PAUL ROCQUET: The structure of phosphorus pentachloride and of phosphorus pentamide  $P(NH_2)_5$ . PIERRE CARRÉ and DAVID LIBERMANN: The reaction of thionyl chloride with *m*- and *p*-amino-benzoic acids. ROBERT LANTZ: Study of the mechanism of the monosulphonation of naphthalene. GEORGES DARZENS and ANDRÉ LÉVY: The action of organomagnesium compounds on methylnaphthalenic and phenanthrenic esters. JACQUES DE LAPPARENT: The stages of the metamorphism of the Samos emeries. PIERRE DRACH: The modifications undergone by the skeleton in the decapod Crustacea before casting the shell. GEORGES A. NADSON and MME. CATHERINE STERN: The action of metals at a distance on germinating seeds. The inhibiting effect on growth produced by plates of various metals is shown to depend on the radio-activity of the surrounding air. MME. VÉRA DANTCHAKOFF: The differences of sensibility of tissue receivers towards folliculin at various embryonic stages. MME. MARIE PHISALIX and FÉLIX PASTEUR: The action of short waves on antivenom snake sera as well as on their neutral mixtures with the corresponding poisons. THÉOPHILE CAHN and JACQUES HOUGET: The transport of lipids in the animal organism. ANDRÉ BOVIN and MME. LYDIA MESROBEANU: The presence of a 'complete' antigen and of a 'residual' antigen in various bacteria. A. BESREDKA, I. MAGAT and P. BESNARD: The importance of the mode of entrance in the evolution of the Pearce-Brown epithelioma. Testicular epithelioma of the rabbit, resulting in fatal generalised cancer, changes its character when it is inoculated under the skin. The tumour on the skin, although epitheliomatous in structure, is benign and is resorbed. PIERRE LÉPINE: The comparative action of immersion in glycerol and of freezing on the preservation of the virulence of rabic marrows. The usual method of preservation in glycerol at about 0° C. leads to a gradual loss in activity, due to the action of the glycerol. Freezing at -10° C. leads to no loss of activity for at least 70 days. CONSTANTIN LEVADITI, RENÉ MARTIN, ANTOINE BONNEFOI and MME. RACHEL SCHEN: The etiology of mumps. RAYMOND-HAMET: Some pharmacological effects of ergometrine, a new alkaloid from ergot of rye. JEAN CULLÉ, CHELLE and BERLUREAU: The identity of French and Algerian ovine anaplasmosis.

## LENINGRAD

Academy of Sciences (C.R., 2, Nos. 3-4, 1935). A. GELFOND: Approximations of transcendent numbers by algebraic numbers. J. PRIVALOV: Some questions of the theory of subharmonic functions (2). E. KUZNECOV: The law of probability of an accidental vector. A. POPOV: Some results obtained by V. Brun. I. S. ASTAPOVICH and V. K. FEDYNSKIJ: Heights of meteors. G. KRUTKOV: A note on the

'great complexes' of Gibbs and the method of Darwin and Fowler. W. ARKADJEV: Magnetic and electric spectra in high frequency. V. FREDERICKS, G. MICHAJLOV and D. BENESZEWICZ: Electroconductivity of an anisotropic fluid. V. FESEKOV: Luminosity of the night sky at Kitab, Tashkent and Kuchino. N. N. KALITIN: Intensity of the radiation from the sky at wave-lengths 3292 Å., 3595 Å. and 3944 Å. E. A. SHILOV and G. V. KUPINSKAJÁ: Rate of hydrolysis of chlorine. N. D. ZELINSKIJ: Catalytic aromatisation of benzines. A. L. KLEBANSKIJ, U. A. DRANICINA and I. M. DOBROMILSKAJA: A new trimeric combination of acetylene, acetylenyldivinyl. N. I. KOBOZEV, S. S. VASILJEV and E. E. HALBRAICH: Catalytic influence of mercury vapour on the cracking of methane in a glow discharge. V. V. TCHELINZEV: Oxonic compounds. Acid compounds of chinones and their chlorination and bromination. G. V. TCHELINZEV and E. D. OSETROVA: The  $\alpha$ -benzoyl-butyrolactone,  $\gamma$ -benzoyl-propyl-alcohol and  $\gamma$ -benzoyl-propyl-bromide. M. K. DJAKOVA and A. V. LOZOVJOJ: Hydrogenation of Cheliabinsk brown coal. V. TETERIN and A. IVANOV: Investigations on the synthesis of vitamin A. (1) Action of magnesium on a mixture of 1,4-dibrombutene-2 and ionon. A. E. FERSMANN: Energy indices in geochemistry. S. D. CHETVERIKOV and A. F. FIOLETOVA: Celadonite from Koktebel, Crimea. V. I. DANILOVICH: Scheme of stratigraphy of the Khingan complex. O. S. VIALOV: A classification scheme of tertiary strata in Ferghana. O. S. VIALOV, S. F. MASHKOVCEV and G. I. SHATOV: Cretaceous basalt in Ferghana. O. L. EINOR: A detailed stratigraphical section of the super-carboniferous of the Kizel district, Urals. P. P. LAZAREV: The action of a condenser discharge from the point of view of the ionic theory of excitation. D. KOSTOFF and I. A. AXAMITNAJA: Studies on polyploid plants (9). Chemical analysis of diploid and their autotetraploid plants. L. P. BRESLAVEZ: Differential fertilisation of the hemp plant. B. M. GOLUSH: Changes of the plasma permeability induced by temperature effects. R. M. BARCINSKIJ: The agent stimulating sprouting of *Orobanche cumana* seeds. S. V. SOLDATENKOV: Data on the chemistry of the artificial ripening of the Japanese persimmon (*Diospyros kaki*, L.). I. KOZHANCHIKOV: Role of anoxybiotic processes in the larval diapause of some *Pyralidae*. L. K. LOZINA-LOZINSKIJ: The anabiosis of larvae of *Pyrausta nubilalis*, Hübn., after freezing. J. D. KIRSCHENBLATT: The problem of the origin of some nidicoles (nest dwellers). B. A. ZENKOVICH: Whale fœtuses.

## MELBOURNE

Royal Society of Victoria, July 12. F. CHAPMAN and IRENE CRESPIN: Foraminiferal limestone of Eocene age from North-West Division, Western Australia. Eocene sedimentary rocks have been discovered for the first time in Australia, during the survey by Messrs. E. A. Rudd and D. Dale Condit, of the Bullara Area. Two samples of limestones from slightly different localities contain a foraminiferal fauna of a Lower to Middle Eocene age. R. A. KEBLE: Victorian Tertiary flora and its influence on sedimentation. The plant beds at Narracan, Dargo, Darlimurla, Bogong, Berwick and probably Moonee Ponds are regarded as of Eocene age, those at Bacchus Marsh, Mornington, Haddon and the lignites at Yallourn (Morwell), Altona and other places as Oligocene, the Pitfield plant bed as Lower Miocene, and the Sentinel Rock plant bed as late Miocene. The flora indicates

that a subtropical climate persisted to the middle of the Miocene and the vegetation was similar to that in the region of the Tropic of Capricorn. The Sentinel Rock flora suggests a temperate climate and vegetation similar to that in Victoria and Tasmania.

## VIENNA

Academy of Sciences, June 13. ERNST ROUSCHAL: The dependence of the intake of water by entire plants on the temperature. The lowered absorption of water brought about by cooling the roots of plants to 0° C. does not resume its normal value when the temperature is afterwards made normal, and the course of the recovery varies with different plants. GERHARD KIRSCH and FRITZ RIEDER: Disintegration of nitrogen by neutrons. In this disintegration, two processes, both connected with capture of the neutron, take place. In one, an  $\alpha$ -particle and B<sup>11</sup> are formed by emission, and in the other, which is much rarer and is effected mainly by the more rapid neutrons, C<sup>14</sup> arises, presumably by proton emission. HERBERT SCHOBER: Measurement of the daily and monthly variation in the length of the ultra-violet for the solar and zenith spectra at Watten (Tyrol). OTTO DISCHENDORFER: Condensation of benzoin and hydroquinone.

## Forthcoming Events

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

Sunday, September 1

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Birds".\*

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (NORWICH MEETING)

Wednesday, September 4

At 8.30 p.m.—Prof. W. W. Watts: "Form, Drift and Rhythm of the Continents" (Presidential Address in the Agricultural Hall).

Thursday, September 5

At 10 a.m.—Prof. W. N. Haworth: "The Molecular Structure of Carbohydrates" (Presidential Address to Section B). Prof. F. Balfour-Browne: "The Species Problem" (Presidential Address to Section D). Prof. F. Debenham: "Some Aspects of the Polar Regions" (Presidential Address to Section E). Mr. J. S. Wilson: "Stability of Structures" (Presidential Address to Section G).

Friday, September 6

At 10 a.m.—Dr. F. W. Aston: "The Story of Isotopes" (Presidential Address to Section A). Prof. G. Hickling: "Some Geological Aspects of Recent Research on Coal" (Presidential Address to Section C). Prof. J. G. Smith: "Economic Nationalism and Foreign Trade" (Presidential Address to Section F). Dr. Ll. Wynn Jones: "Personality and Age" (Presidential Address to Section J). Dr. A. W. Pickard-Cambridge: "Education and Freedom" (Presidential Address to Section L). At 2 p.m.—Conference of Delegates of Corresponding Societies. Prof. P. G. H. Boswell: "Preservation of Sites of Scientific Interest in Town and Country Planning" (Presidential Address). At 8.15 p.m. Dr. S. J. Davies: "Diesel Engines and Coastal Shipping" (Agricultural Hall Assembly Room).

## Official Publications Received

## Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1639 (T. 3527 revd.): Wind Tunnel Wall Interference on Pitching Moments of Large Models in Duplex Tunnel. By W. L. Cowley and G. A. McMillan. Pp. 13+4 plates. 9d. net. No. 1648 (T. 3628): Reaction on a Wing whose Angle of Incidence is changing Rapidly; Wind Tunnel Experiments with a Short Period Recording Balance. By W. S. Farren. Pp. 24+30 plates. (London: H.M. Stationery Office.) 2s. 3d. net.

The Harper Adams Adviser. Advisory Report No. 10: A Review of Advisory Work in the West Midland Province, 1934-1935. Pp. 24. (Newport, Shropshire: Harper Adams Agricultural College.)

Mines Department. Thirteenth Annual Report of the Safety in Mines Research Board including a Report of Matters dealt with by the Health Advisory Committee, 1934. Pp. 134. (London: H.M. Stationery Office.) 2s. net.

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1934. Pp. x+261. (London: H.M. Stationery Office.) 4s. net.

The North of Scotland College of Agriculture. Calendar, Session 1935-1936. Pp. viii+128. (Aberdeen: North of Scotland College of Agriculture.)

Technical Publications of the International Tin Research and Development Council. Series A, No. 19: The Use of Sodium Sulphite as an addition to Alkaline Detergents for Tinned Ware. By Dr. R. Kerr. Pp. 12. Series A, No. 20: The Twinning of Single Crystals of Tin. By Dr. Bruce Chalmers. Pp. 16. Series B, No. 2: Equilibrium Diagrams of Binary Alloys of Tin. By Dr. E. S. Hedges and Dr. C. E. Homer. Pp. 90. Series D, No. 2: Black Spots on Tin and Tinned Ware. By Sven Brenner. Pp. 27. (London: International Tin Research and Development Council.)

## Other Countries

Regenwaarnemingen in Nederlandsch-Indië. Vier und vijftigste Jaargang, 1932. Pp. 129. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.)

Colony of Mauritius: Department of Agriculture. Fifth Annual Report of the Sugarcane Research Station for the Year 1934. Pp. 49. (Port Louis: Government Printer.)

Publications of the Observatory of the University of Michigan. Vol. 6, No. 9: An Ephemeris of 467 A.D. By Heber D. Curtis and Frank E. Robbins. Pp. 77-100+2 plates. (Ann Arbor, Mich.: University of Michigan.)

Obras completas y Correspondencia científica de Florentino Ameghino. Vol. 16: Formaciones sedimentarias de Patagonia. Edición Oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcell. Pp. 747+193 plates. (La Plata: El Gobierno de la Provincia de Buenos Aires.)

Commonwealth Bureau of Census and Statistics, Canberra. Official Year Book of the Commonwealth of Australia. No. 27, 1934. Prepared by E. T. McPhee. Pp. xxxii+942. (Canberra: Government Printer.) 5s.

U.S. Department of Agriculture. Technical Bulletin No. 477: *Apanteles solitarius* (Ratzeburg), an introduced Braconid Parasite of the Satin Moth. By D. L. Parker. Pp. 18. (Washington, D.C.: Government Printing Office.) 5 cents.

Publications of the Astronomical Observatory of the Warsaw University. Vol. 9, Pp. iii+76. (Warsaw: Astronomical Observatory.)

Tanganyika Territory: Department of Agriculture. Annual Report, 1934. Pp. 141. (Dar es Salaam: Government Printer.) 4s.

The Imperial College of Tropical Agriculture. The Principal's Report for the Year 1933-34 and the Accounts for the Year ended August 31, 1934. Pp. 34. (Trinidad and London: Imperial College of Tropical Agriculture.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 14, 1932. iv. Meteorologiska iakttagelser i Sverige, Band 74. Pp. x+107. (Stockholm: Statens Meteorologiska-Hydrografiska Anstalt.) 7.00 kr.

Memoirs of the Commonwealth Solar Observatory, Mount Stromlo, Canberra, Australia. Memoir No. 5, Part 1: The Intensity of Fraunhofer Lines in the Region 4036-6600 Å. By C. W. Allen. Pp. 57. Memoir No. 5, Part 2: Fraunhofer Intensity Tables: (a) General Intensity Table, 4277-6600 Å.; (b) Multiplet Intensity Table, 4036-6600 Å. By C. W. Allen. Pp. 96. (Canberra: Government Printer.)

Institut de France: Académie des Sciences. Annuaire pour 1935. Pp. 407. (Paris: Gauthier-Villars.)

Transactions of the Academy of Science of Saint Louis. Vol. 29, No. 1: Natural History of the Alligator Lizards. By Henry S. Fitch. Pp. 38+4 plates. (St. Louis, Mo.: Washington University.)

Smithsonian Miscellaneous Collections. Vol. 91, No. 21: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. Fourteen New Species of Foraminifera. By John A. Cushman. (Publication 3327.) Pp. ii+9+3 plates. Vol. 91, No. 22: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. Two New Foraminifera of the Genus Textularia. By Cecil G. Lallier. (Publication 3328.) Pp. ii+2+1 plate. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of Agriculture. Circular No. 349: The Disposal by Burial of Fruit infested with Larvæ of the Mexican Fruit Fly. By C. C. Plummer and W. E. Stone. Pp. 16. (Washington, D.C.: Government Printing Office.) 5 cents.

Ministry of Finance, Egypt: Coastguards and Fisheries Service: Fisheries Research Directorate. Notes and Memoirs, No. 6: The Pharynx and Intestinal Tract of the Egyptian Mullet—Mugil Cephalus and Mugil Capito. Part 2: On the Morphology and Histology of the Alimentary Canal in Mugil Capito (Tobar). By Dr. F. M. Ghazzawi. Pp. ii+31. Notes and Memoirs, No. 7: Repeuplement Poissonnier des sources à l'Oasis de Siwa. Par Dr. H. Faouzi. Pp. ii+12+5 plates. Rapport sur les Pêcheries d'Égypte en 1932. Par Ibrahim Abd-el-Galil Abou-Samra. Pp. xx+117. (Cairo: Government Press.)

## Recent Scientific and Technical Books

Volumes marked with an asterisk (\*) have been received at "NATURE" Office

## Mathematics: Mechanics: Physics

**Black, Newton Henry.** An Introductory Course in College Physics. Demy 8vo. Pp. ix + 714. (New York: The Macmillan Co., 1935.) 15s. net.\*

**Blackett, P. M. S.** Conférences du Collège de France publiées sous les auspices et aux frais de la Fondation Singer-Polignac. 1: La radiation cosmique; aperçu général. Roy. 8vo. Pp. 23 + 4 plates. 10 francs. 2: La radiation cosmique; la méthode de la chambre de C. T. R. Wilson (commandée par compteurs de Geiger-Müller). Roy. 8vo. Pp. 25 + 3 plates. 8 francs. 3: La radiation cosmique; l'action du champ magnétique terrestre. Roy. 8vo. Pp. 20 + 1 plate. 7 francs. 4: La radiation cosmique; la perte d'énergie par ionisation. Roy. 8vo. Pp. 21 + 7 plates. 10 francs. (Actualités scientifiques et industrielles, 230-233.) (Paris: Hermann et Cie, 1935.)\*

**Born, Max.** Atomic Physics. Authorized translation from the German edition by John Dougall. Med. 8vo. Pp. xii + 352. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1935.) 17s. 6d. net.\*

**Condon, E. U., and Shortley, G. H.** The Theory of Atomic Spectra. Sup. Roy. 8vo. Pp. xiv + 442. (Cambridge: At the University Press, 1935.) 42s. net.\*

**Couderc, P., et Balliccioni, A.** Premier livre du tétraèdre: à l'usage des élèves de première, de mathématiques, des candidats aux grandes écoles et à l'agrégation. Roy. 8vo. Pp. viii + 204. (Paris: Gauthier-Villars, 1935.) 40 francs.\*

**Davies, W. G.** School Certificate Examples in Physics. Cr. 8vo. Pp. vii + 176. (London: Edward Arnold and Co., 1935.) 2s. 6d.\*

**Garnier, René.** Leçons d'algèbre et de géométrie à l'usage des étudiants des Facultés des Sciences. (Cours de la Faculté des Sciences de Paris.) D'après la rédaction de Badrig Guëndjian. Tome 1: Algèbre linéaire, homographie, équations tangentielles. Roy. 8vo. Pp. viii + 233. (Paris: Gauthier-Villars, 1935.) 40 francs.\*

**Guébin, G.** Exposés de physique moléculaire, 10: Structure nucléaire. (Actualités scientifiques et industrielles, 247.) Roy. 8vo. Pp. 34. (Paris: Hermann et Cie, 1935.) 10 francs.\*

**Hoare, Charles.** The Slide Rule and How to use It: containing Full, Easy and Simple Instructions to perform all Business Calculations with Unexampled Rapidity and Accuracy. (Technical Press Manuals.) Cr. 8vo. Pp. vi + 104. (London: The Technical Press, Ltd., 1935.) 4s. net.\*

**Institut International de Physique Solvay.** Structure et propriétés des noyaux atomiques. Rapports et discussions du Septième Conseil de Physique tenu à Bruxelles du 22 au 29 Octobre 1933, sous les auspices de l'Institut International de Physique Solvay. Roy. 8vo. Pp. xxv + 365. (Paris: Gauthier-Villars, 1934.) 75 francs.\*

**Internationale Tabellen zur Bestimmung von Kristallstrukturen; International Tables for the Determination of Crystal Structures; Tables Internationales pour la Détermination des Structures des Cristaux.** Imp. 8vo. Band 1: Gruppentheoretische Tafeln; Tables on the Theory of Groups; Tables sur la théorie des groupes. Pp. xii + 452. Band 2: Mathematische und physikalische Tafeln; Mathematical and Physical Tables; Tables mathématiques et physiques. Pp. viii + 453-692. (Berlin: Gebrüder Borntraeger; London: G. Bell and Sons, Ltd.; Paris: Les Presses universitaires de France; New York: Chemical Catalog Co.; Amsterdam: N. V. Noordhollandsche Uitgevers Maatschappij, 1935.) 33 gold marks.\*

**Kronig, R. de L.** The Optical Basis of the Theory of Valency. (Cambridge Series of Physical Chemistry.) Demy 8vo. Pp. x + 246. (Cambridge: At the University Press, 1935.) 16s. net.\*

**Meitner, Lise, und Delbrück, Max.** Der Aufbau der Atomkerne: natürliche und künstliche Kernumwandlungen. Demy 8vo. Pp. iv + 62. (Berlin: Julius Springer, 1935.) 4.50 gold marks.\*

**Middleton, L. R.** A Textbook of Light. Ex. Cr. 8vo. Pp. viii + 288. (London: G. Bell and Sons, Ltd., 1935.) 6s.\*

**Miller, Carl W.** An Introduction to Physical Science. Second edition. Demy 8vo. Pp. xiv + 409. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 15s. net.\*

**Nightingale, E., and Pearson, W.** General Physics. Cr. 8vo. Pp. viii + 553. (London: G. Bell and Sons, Ltd., 1935.) 6s. 6d.\*

**Pleury, Pierre.** Leçons de métrologie, générale et appliquée, 1: Généralités sur les mesures; préparation, exécution, interprétation, calculs, unités, législation. (Actualités scientifiques et industrielles, 236.) Roy. 8vo. Pp. 74 + 2 plates. (Paris: Hermann et Cie, 1935.) 15 francs.\*

**Ramsey, A. S.** A Treatise on Hydromechanics. Part 2: Hydrodynamics. Fourth edition. Demy 8vo. Pp. xii + 415. (London: G. Bell and Sons, Ltd., 1935.) 16s. net.\*

**Rocard, Y.** Théories mécaniques (hydrodynamique—acoustique). 2: Propagation et absorption du son. Roy. 8vo. Pp. 63. 15 francs. 3: La stabilité de route des locomotives, Première partie. Roy. 8vo. Pp. 65. 15 francs. (Actualités scientifiques et industrielles, 222, 234.) (Paris: Hermann et Cie, 1935.)\*

**Rossi, B.** Exposés de physique atomique expérimentale, 4: Rayons cosmiques. (Actualités scientifiques et industrielles, 248.) Roy. 8vo. Pp. 48. (Paris: Hermann et Cie, 1935.) 12 francs.\*

**Sponer, H.** Molekülspektren und ihre Anwendung auf chemische Probleme. 1: Tabellen. (Struktur und Eigenschaften der Materie: eine Monographiensammlung, Band 15.) Ex. Cr. 8vo. Pp. vi + 154. (Berlin: Julius Springer, 1935.) 17.60 gold marks.\*

**Swings, P.** La spectroscopie appliquée. (Bibliothèque scientifique Belge.) Cr. 8vo. Pp. 188. (Paris: Hermann et Cie, 1935.) 15 francs.\*

**Teichmann, Horst.** Einführung in die Quantenphysik. (Mathematisch-physikalische Bibliothek, Reihe 2, Band 13.) Cr. 8vo. Pp. vi + 93. (Leipzig und Berlin: B. G. Teubner, 1935.) 2.80 gold marks.\*

**Valadares, Manuel.** Exposés de radioactivité et de physique nucléaire, 5: Transmutation des éléments par des particules accélérées artificiellement. (Actualités scientifiques et industrielles, 245.) Roy. 8vo. Pp. 30 + 1 plate. (Paris: Hermann et Cie, 1935.) 10 francs.\*

**Volterra, Vito, et d'Ancona, Umberto.** Exposés de biométrie et de statistique biologique, 5: Les associations biologiques au point de vue mathématique. (Actualités scientifiques et industrielles, 243.) Roy. 8vo. Pp. 97. (Paris: Hermann et Cie, 1935.) 20 francs.\*

**White, W. H.** A Complete Physics written for London Medical Students and General Use. Demy 8vo. Pp. vii + 848. (London: Richard Clay and Sons, Ltd., 1935.) 15s.\*

**Wyckoff, Ralph W. G.** The Structure of Crystals. Supplement for 1930-1934 to the second edition. (American Chemical Society Monograph Series, No. 19A.) Med. 8vo. Pp. 240. (New York: Reinhold Publishing Corporation, 1935.) 6 dollars.\*

## Engineering

**Board of Education: Science Museum.** Handbook of the Collections illustrating Aeronautics, 1: Heavier-than-Air Aircraft; a Brief Outline of the History and Development of Mechanical Flight with reference to the National

Aeronautical Collection, and a Catalogue of the Exhibits. By M. J. B. Davy. Second edition (revised and enlarged). Roy. 8vo. Pp. 125 + 26 plates. (London: H.M. Stationery Office, 1935.) 2s. 6d. net.\*

Department of Scientific and Industrial Research: Building Research. Technical Paper No. 18: Correlation between Laboratory Tests and Observed Temperatures in Large Dams. By N. Davey. Roy. 8vo. Pp. iv + 25 + 2 plates. (London: H.M. Stationery Office, 1935.) 9d. net.\*

Ferns, J. L. Meter Engineering: a Practical Book on the Installation, Testing and Maintenance of Electricity Meters. Second edition. Cr. 8vo. Pp. viii + 317. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 10s. 6d. net.\*

Marks, Percy L. Chimneys and Flues: Domestic and Industrial. Cr. 8vo. Pp. 131. (London: The Technical Press, Ltd., 1935.) 4s. net.\*

Philpott, Stuart F. Modern Electric Clocks: Principles, Construction, Installation and Maintenance. Second edition. Cr. 8vo. Pp. ix + 214. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 7s. 6d. net.\*

Pippard, A. J. Sutton, and Pritchard, Capt. J. Laurence. Aeroplane Structures. Second edition. Med. 8vo. Pp. xvi + 368 + 13 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 21s. net.\*

Scroggie, M. G. Television. (Blackie's "Technique" Series.) Cr. 8vo. Pp. ix + 68 + 7 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1935.) 3s. 6d. net.\*

Smith, P. H. Diesel Engines: Excessive Lubricating Oil Consumption. Cr. 8vo. Pp. ix + 85. (London: Constable and Co., Ltd., 1935.) 3s. 6d. net.\*

### Chemistry: Chemical Industry

Bennett, H. Practical Everyday Chemistry: How to make what you Use; No Theory—Practical Modern Working Formulae for making Hundreds of Products. Demy 8vo. Pp. xv + 305. (New York: Chemical Publishing Co. of New York; London: W. and G. Foyle, Ltd., 1934.) 10s. net.\*

Bodansky, Meyer, and Fay, Marion. Laboratory Manual of Physiological Chemistry. Third edition. Med. 8vo. Pp. vii + 274. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 10s. net.\*

Department of Scientific and Industrial Research: Building Research. Bulletin No. 6: The Prevention of Corrosion of Lead in Buildings. By F. L. Brady. Second edition, revised. Roy. 8vo. Pp. iv + 4 + 1 plate. (London: H.M. Stationery Office, 1935.) 3d. net.\*

Hall, William Thomas. Textbook of Quantitative Analysis. Second edition. Med. 8vo. Pp. ix + 350. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 15s. net.\*

Langenbeck, Wolfgang. Die organischen Katalysatoren und ihre Beziehungen zu den Fermenten. Roy. 8vo. Pp. v + 112. (Berlin: Julius Springer, 1935.) 7.50 gold marks.\*

Martin, Geoffrey. Industrial and Manufacturing Chemistry. Part 2: Inorganic; a Practical Treatise. Vol. 1. Fifth edition, revised by Geoffrey Martin. Roy. 8vo. Pp. xx + 496. (London: The Technical Press, Ltd., 1935.) 28s. net.\*

Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Advisory Board: Roger Adams, H. T. Clarke, J. B. Conant, Henry Gilman, C. S. Marvel, F. C. Whitmore. Editorial Board: Carl R. Noller (Editor-in-Chief), W. H. Carothers, L. F. Fieser, W. W. Hartman, John R. Johnson, R. C. Fuson, C. F. H. Allen (Secretary to the Board). Vol. 15. Med. 8vo. Pp. v + 104. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 8s. 6d. net.\*

Rosenthaler, L. Toxikologische Mikroanalyse: Qualitative Mikrochemie der Gifte u.a. gerichtlich-chemisch wichtiger Stoffe. Roy. 8vo. Pp. viii + 368. (Berlin: Gebrüder Borntraeger, 1935.) 25.50 gold marks.\*

Steels, H. Properties of Matter. Cr. 8vo. Pp. vi + 173. (London: John Murray, 1935.) 4s.\*

### Technology

Altmannsberger, K. Neuzeitliche galvanische Metallveredelung: Wege und Winke zur Erziehung hochwertig: Metallauflagen und Arbeitsmethoden der heutigen Galvanotechnik. Zweite Auflage. 8vo. Pp. 160. (Coburg: Müller und Schmidt, 1935.) 5 gold marks.

Best-Maugard, Adolfo. A Method for Creative Design. New and revised edition. Ex. Cr. 8vo. Pp. viii + 145. (London: George Allen and Unwin, Ltd., 1935.) 6s. net.

Bullens, D. K. Steel and its Heat Treatment. Third edition, rewritten and reset. Med. 8vo. Pp. xiii + 580. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 25s. net.\*

Crook, Thurman C. Simplified Mechanical Drawing: a Textbook for Beginners. Revised edition. Med. 8vo. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 7s. 6d. net.

French, Thomas E. A Manual of Engineering Drawing for Students and Draughtsmen. Fifth edition, revised and enlarged. Med. 8vo. Pp. 493. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 18s. net.

Hewitt-Bates, J. S. Bookbinding for Schools: a Textbook for Teachers and Students in Elementary and Secondary Schools and Training Colleges. Second revised edition. Demy 8vo. Pp. vii + 128 + 11 plates. (Leicester and London: The Dryad Press, 1935.) 6s. net.

Rosenhain, Walter. An Introduction to the Study of Physical Metallurgy. Revised and partly re-written by John L. Haughton. Third edition. Demy 8vo. Pp. xvi + 368 + 36 plates. (London: Constable and Co., Ltd., 1935.) 20s. net.\*

Sawer, D. D. Art in Daily Life for Young and Old. Demy 8vo. Pp. xvi + 193 (68 plates). (London: B. T. Batsford, Ltd., 1935.) 10s. 6d. net.

### Geography: Travel

Armelin, Gisèle. Un voyage aux Indes. Cr. 8vo. Pp. 99. (Paris: A. Messein, 1935.) 12 francs.

Benn, Wedgwood, and Benn, Margaret. Beckoning Horizon: a Journey Round the World. Demy 8vo. Pp. 408. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1935.) 12s. 6d. net.

Brown, Ivor. The Heart of England. Demy 8vo. Pp. viii + 120 + 97 plates. (London: B. T. Batsford, Ltd., 1935.) 7s. 6d. net.

Calvert-Wilson, J. M. The World Around Us. Book 4: The Home-Lands. Imp. 16mo. Pp. 247 + 4 plates. (London and Edinburgh: W. and R. Chambers, Ltd., 1935.) 2s.

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