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"To the solid ground
Of nature trusts the Mind that builds for aye."—WORDSWORTH.

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CONTENTS

Production and Planning

GRADUALLY the industrial and commercial world is being brought round to the acceptance of the idea of the wisdom of, and the necessity for, planning. Planning is being tried in many ways and described by many names. Sometimes trade interests suffice to exercise the necessary control; more often Government intervention is necessary.

Fundamentally, the fact is that at long last it is being recognised that the excessive individualism either of a person, a firm, an industry or a country may be a danger to a nation or to the world, even to the extent of becoming a social crime. National interests are being regarded as a higher ideal than individual interests, while vested interests are viewed with increasing suspicion: the most enlightened think internationally, of mankind. The Fascists' plan to establish the corporate State with limits, within which interests may operate, laid down by the Government, is receiving increasingly serious consideration and support. The limits will be the welfare of the nation as a whole, to which all lesser interests whether of the Right or Left, whether they be employers or workpeople, bankers or other professional men, are subordinate. The 'small man' has become alarmed at the fact that the old system of government has proved quite unable in the last decade to prevent the world, and to a lesser extent Great Britain, being nearly ruined by an abundance which is produced below cost.

The combination of three factors, ample finance, applied science and industrial technique, including improved transport, has enabled the world to produce goods at an extraordinary rate: rationalisation of industry has added to the power to produce goods, but unfortunately there has been no corresponding machinery to enable the goods to be consumed.

Such ingenious attempts to solve this problem as buying by instalments or hire purchase have not really affected consumption as they have chiefly been confined to luxury articles. The outstripping of demand by production of the primary commodities has piled up a world unemployment problem of disastrous magnitude, and a vicious circle has been set up of falling prices and unemployment which is proving hard to break.

How planning can be most satisfactorily attempted is the question which awaits an answer. The form must undoubtedly vary according to the commodity. In Britain we all agree as to the danger of too much initiation, control or regulation by Government departments—a fact which has recently been acknowledged by Mr. Runciman. Business men seek beyond all else to avoid Government interference, but their freedom from this control must in return involve some obligation on their part not to over-produce.

As one illustration of the kind of thing to be avoided, what is happening in the lead industries which manufacture white lead and a variety of products from the metal may be cited. The existing old-established firms have been seeking successfully to combine into one organisation during several years past, so as to weld a previously competitive trade into an up-to-date organisation engaged in manufacture, treatment and distribution of lead products on a reasonable manufacturing scale and profit basis. Owing perhaps to the large amount of capital at present existing for which no useful outlet can be found, experimental efforts are now once more being made to establish further plants which, as the existing plants are not fully occupied, are in fact surplus. Such unregulated over-production by newcomers can only lead to disorganisation and loss of capital: it is a fallacy that new processes must of necessity show reduced production costs. The lead industry is setting a good example in going into the titanium paint trade jointly with Imperial Chemical Industries and others, instead of each company acting individually: a healthy industry giving steady employment and manufacturing economically is likely to be set up without detriment to the consumer in regard to the price he will be asked to pay.

The public is already acquainted with the restriction schemes in force for tea and tin, both of which are successfully acting to rescue these industries from impending disaster. The new international scheme of rubber control can be described as highly scientific. Its object is to restrict production so as to bring it into line with consumption and to lessen the present unduly large stocks. Having fixed export quotas for the various producing countries, these are to be maintained at 100 per cent for two months, reduced to 90 per cent for two months, to 80 per cent for two further months and then to 70 per cent. The gradual reduction avoids too great a dislocation at the plantations and likewise prevents too rapid an advance in price at the outset of the scheme which might hinder manufacturing operations. It is expected to take eighteen months at least with export quotas at 70 per cent to bring the world stocks of rubber down to normal. The scheme not only balances output as between the respective producing countries, but also between the plantations and the native small producers: it is a remarkable example of the principles of give and take in the common weal, enforced, let it be said, only with difficulty after all concerned have drunk deeply of the cup of adversity. There are no doubt faults and loopholes for evasion in such a scheme, as Sir Eric Geddes has pointed out, but it is for all concerned to carry it out loyally, for without it the rubber industry could scarcely survive.

In the future it should be possible to put through similar schemes for other commodities with less difficulty. We hold it improper for one nation to hold up any scheme which is in the interest of the world at large merely in order to bargain for better terms. It is likewise improper for a farmer who is planting a restricted acreage by agreement to increase his normal crop on the smaller area by the unusual application of fertilisers. Such action is said to be nullifying many of the attempts to improve things for the farmers in the United States. It should be regarded as unsocial, and penalised accordingly: if the individual will not work for the common good, he invites drastic action by the State.

The world is populated by human beings exercising some degree of thought and not by mechanically controllable units. Consequently

there is always an opportunity for new fields of production which have mass appeal. Salesmanship, above all the selling of new ideas, is the need of the moment, and it is the profession which is the most highly rewarded financially: it should therefore attract the best brains. Motoring, gramophones, radio, the moving and the talking picture, have in turn captured the imagination and the purses of the multitude and given rise to an immense amount of employment. Who knows what other inventions applied physics or chemistry have in store for us? The decaying industries must also take salesmanship and science into partnership as, for example, the railways and shipping. What a difference the pleasure cruise has made to our idle shipping, and the railways will find that we are travel-minded on land too if they produce the right schemes.

A form of national planning which is under trial is that presented by the trade agreements which Great Britain is making with certain countries. The basic idea in these is to ensure more certain markets for certain British commodities, in particular coal, in return for the sacrifice of lesser industries to competition with the foreigner. It is the general view of industry that in the agreements so far made we have sacrificed more than we are likely to gain and that they have been entered into without sufficient expert advice from industry and consideration of their possible repercussions. The principle of these agreements is probably a good one and only experience can enable us to pronounce on their value, but the experiment is one which is undoubtedly well worth trying; nothing is more essential than to stimulate export trade between the nations. Quotas are also an example of planning by the State, though they are best regarded as an offensive and defensive weapon in tariff wars.

Of recent years Great Britain has never been able to make up its mind whether it is to be developed as an industrial or agricultural country. Politically it is the former so far as voting strength is concerned, and it is obvious that so long as our factories could be kept fully occupied in the export trade, it was convenient and necessary as well as cheap to take most of our food from abroad. In the measure that the export trade falls, it is no longer convenient to import and pay for large quantities of foreign food, whilst national considerations of safety in war time demand that a large proportion of our food be produced at home. In consequence partly of the long period of low prosperity, the organisation of agriculture in all its branches is on a much lower plane than that of industry, and in particular the costs of distribution are unduly high; there is unnecessary wastage and an undue proportion of the profits remain in quarters where the risk and the responsibility are least.

Most of these problems are capable of being solved by planning on a county or national scale, provided that the farmer, renowned as an individualist, is prepared to join loyally in co-operative action.

This analysis is of the slightest, but it would seem clear that individualism has failed, that it must be replaced by planning for the common weal. Such planning is best done on the small scale by industries, on the large scale by nations and eventually internationally. Here science can be helpful and it must not stand aside or let itself be held aloof; the problems are bigger ones than the politicians can envisage, and their solution must profit no party end but bring employment, peace and prosperity to all. Party politics are obsolete and harmful; they must be replaced by a government concerned only with the restoration of prosperity and possessing the ability to plan economic production without putting hindrances in the way of invention.

On Caviar for the Community

(1) *Major Mysteries of Science.* By H. Gordon Garbedian. Pp. 320+64 plates. (London: Selwyn and Blount, Ltd., n.d.) 18*s*.

(2) *Electrical Conceptions of To-day: a Lucid Explanation of many of the Latest Theories concerning Atoms, Electrons and other matters relating to Electricity.* By Charles R. Gibson. Pp. 284+8 plates. (London: Seeley, Service and Co., Ltd., 1933.) 6*s*. net.

(3) *Exploring the Upper Atmosphere.* By Dorothy Fisk. Pp. 166. (London: Faber and Faber, Ltd., 1934.) 6*s*. net.

(4) *The Progress of Science: an Account of Recent Fundamental Researches in Physics, Chemistry and Biology.* By J. G. Crowther. Pp. x+304+12 plates. (London: Kegan Paul and Co., Ltd., 1934.) 12*s*. 6*d*. net.

IT is something of a commonplace to say that we might well suspend research work and devote ourselves to the formidable task of ensuring

that the products of achieved research are assimilated into the life-stream of the community. This is just as true, and just as misleading, as another commonplace about the world disease which, with an unconscious irony of bitter flavour, is called 'over-production'. If, in fact, the producers who have done their work so well could readily—and temporarily—be transformed into distributors, of equal merit, then in the wider and narrower sphere alike the world would be better off. But, in both spheres, the bravest of all new worlds would result from leaving the uniquely qualified producers to continue their beneficent work, and entrusting the work of dissemination and assimilation to other minds of quantitatively equal but qualitatively different merit.

Any newspaper will suffice to justify the adjective 'formidable' as appropriate to the task of interpreting, to the individual units of the social system, the significance of science in the life of the world, the nation and the citizen. Any bookshelf will reinforce the evidence. The radical fault lies, probably, no less in the mind of the investigator than in that of the plain citizen. It is by no accident that the epithet 'best-seller' is almost as violently abusive in relation to scientific literature as in æsthetic. The explorer has always been suspicious of the *entrepreneur*. Yet, somehow, by rational process, we must prevent a repetition, in this matter of scientific knowledge, of the disastrous history of distributive trade. Complicated though the problem be by the fact that the scientific mind is scientific only over limited tracts of subject matter, of time and of personal contact, yet its solution is vital to the advance of civilisation.

Huxley and Tyndall intrude so frequently into discussions of this kind that they must be brought into perspective. Without going back to King Charles's Head, or even to Queen Anne, one may at least say, fairly, that it is doubtful whether Huxley or Tyndall were more powerful expositors than are Jeans and Eddington ; and it is scarcely so much as doubtful that they did as little to bring science *into* everyday life as do these distinguished contemporaries of ours. All four have been more valuable as anæsthetists than as physicians. The concern of everyone with a sense of the community must, at present, be less with Lethe than with the Clyde.

The four books before us are representative of four approaches to the interpretation of scientific work to the ordinary reader. All succeed in a measure of '*vulgarisation*' in the pure French sense, with no trace of 'vulgarisation' in the English sense. There is in them, that is, no trace of what an inspired reviewer once called "a plumber's dream of Paradise". But in Mr. Crowther's book alone is there any useful approach to the major problem of scientific motive and economic consequence. All four have the characteristic defects of their kind : one can pick from them gems of the customary 'modes', the plain tale, the anthropomorphic, the coyly persuasive, the roseate romantic, the rhapsodic hysteric. But since none of them pretends to be more than its title suggests, and since each honestly and interestingly conveys a truthful picture within the indicated field, they are a little unfortunate to find themselves involved in a conflict between the very different 'realities' of the metaphysicist and the politician. They merit discussion on their selected planes.

(1) Mr. Garbedian's is the least satisfactory of the four, yet it is exceedingly interesting and stimulating. "Each of the twenty-seven chapters deals with a separate distinct problem of modern science", and the problems range from sources of available energy, through lengths of human life, through cosmic radiation to cosmogony. This wide sweep is beyond the powers of any one interpreter from inside, and the lack of a completely satisfying flavour is a natural consequence of a treatment which is necessarily reporting rather than interpretation. The facts are generally accurately reported, the comments of a somewhat assorted team of authorities are cited, but there is a lack of synthesis and correlation.

(2) Dr. Gibson has an easier task, and achieves it more successfully. He has stirred a great population of growing minds to enthusiasm for "the science of to-day", and this issue in a new form of his "Modern Conceptions of Electricity" is well fitted to continue his important work in that direction. The opportunity offered by the reshaping should, however, have been used for some necessary correction and modification, for the conceptions presented are not wholly those of to-day, but of a yesterday which was in many ways more favourable to simple exposition but far less stimulating than the very thrilling to-day of atomic and philosophic physics. The particular "to-day" of this volume contained no neutron, no positive electron and no isotope of oxygen ; it would be unreasonable to demand that it should have reached isotopes of hydrogen, but these intermediate advances ought to have found a

place in any 1933 printing. Up to the chosen yesterday, the conceptions are pleasingly set out; the only really misleading points noticed are the quotation of a shockingly superficial dismissal, by Dolbear, of the problem of earth currents, and the apparent suggestion, a few pages later, that the luminosity of the nebulæ is due to bombardment by electrons from our sun. These, together with the over-frequent numerical errors (as in the atomic weight of chlorine), will prove stumbling blocks on an otherwise pleasant and not hazardous path.

(3) Miss Fisk gives a lively, attractive and almost invariably reliable account of the knowledge—fragmentary though it still is—brought down from the upper atmosphere by the manned balloon, the *ballon sonde*, the sound wave, the radio wave, the meteor, the cosmic ray and the gamut of light waves. Her book is unique in its kind, and may be very cordially recommended to those who need convincing that romance is not confined to romances, nor even to bringing up the nine-fifteen. The tight-rope of scientific accuracy within universal readability has seldom been more charmingly walked.

Both the ozonosphere and the ionosphere will want reconstruction in the second edition. Miss Fisk has failed to record the scurvy trick by which the ozone workers, having enticed the acoustic workers into finding data which fitted admirably with an ozone 'layer' at 50 kilometres, have recently destroyed the fit by bringing their ozone down to much lower levels. The situation as to the structure and ionising agencies of the ionosphere is much clearer, that as to radio echoes of long delay much less clear, than Miss Fisk succeeds in making them. The blame for the defects of her discussion of these subjects must be shared with the radio-physicists. She might well, however, eliminate the suggestion that the "D layer varies in height between about 25 to 30 miles"; there is no safe experimental or theoretical basis for believing this. Clearer recognition of the distinction between 'equivalent' and geometric paths in the ionosphere would have modified the author's statements alike about the *F* layer and about echoes of long delay.

It is not easy to understand why the author rejects the officially accepted record for low temperature at ground level, − 94° F. at Verkhoiansk, Siberia, January 3, 1885, in favour of a modest − 76° F. on the Great Ice Barrier, Ross Sea, July 6, 1911, and Harang's aurora at 40 miles height has escaped mention in the appropriate chapter. These are almost the only points on which the author has gone astray, save in a very misleading juxtaposition of glowing coals and hot-wire microphones. The book is, let us repeat, novel, attractive and accurate, and our distinguished contemporary, *Punch*, had no excuse whatever for misunderstanding Miss Fisk's statement about Martian ballistics.

(4) Mr. Crowther alone offers some hold for the ponderous harpoon with which we embarked on our present fishing expedition. Mr. Garbedian's goldfish—with his frequent sporadic assertion that they may lay golden eggs—Dr. Gibson's honestly anatomical herring, and Miss Fisk's flying fish, should have been taken otherwise, but Mr. Crowther does recognise clearly that scientific culture is not a culture *in vitro*. He recognises that the æsthetic exercise of scientific research, desirable and precious as it is, cannot be understood without reference to the social medium in which it grows. "This book is intended . . . to make him [the general reader] more impatient of leaders who cannot take a scientific view of human problems." It is equally valuable in helping him to take a human view of scientific problems.

The first three chapters give fascinatingly contrasted pictures of the atmosphere of notable research institutions in England, Denmark and the Soviet Union. Later chapters proceed from the already well-explored themes of the expanding universe and stellar evolution to the less remote and less *vulgarisées* stories of penetrating radiations, the positron and heavy hydrogen. The author then turns to three chapters of biological significance, on "The Chemistry of Human Evolution", on "Human Heredity" and on "Pernicious Anæmia".

The book is full of sound fact, of scientific judgment and of stimulating comment. But the quality which sets it apart from the more superficial 'romance of science' is its steady emphasis on the interrelationship of scientific research and social environment. Mr. Crowther will help the scientific worker to realise that the 'world around us' is after all nearer our hearts than the 'universe around us'. To those who make it a demerit that he brings politics into his science he can fairly reply that this importation is the only available corrective to the older process, already disastrously advanced, of bringing the products of science—without its method or its wisdom—into politics.

The London Clay Flora

British Museum (Natural History). *The London Clay Flora.* By Eleanor Mary Reid and Marjorie Elizabeth Jane Chandler. Pp. viii+561+33 plates. (London: British Museum (Natural History), 1933.) 50*s*.

IN this noble volume recently published by the Trustees of the British Museum, Mrs. Reid and Miss Chandler describe the results of an intensive study of thousands of fruits and seeds strewn along the foreshore of Sheppey and Herne Bay by the action of the sea on the cliffs of clay in which the drifted debris was originally embedded. The London Clay, reaching in places a thickness of 500 ft., is exposed at the surface or lies beneath superficial accumulations over a large area in Middlesex, Surrey, Essex, Kent and in the Hampshire basin. In addition to remains of crocodiles, turtles, shells of *Nautilus* and other marine creatures, the clay contains innumerable samples of vegetation, mainly seeds and fruits, which grew on the northern shore of the Tethys Sea.

The authors summarise the history of our knowledge of a flora that has exercised the ingenuity of writers since the early days of the eighteenth century. The first scientific attempt to study the fossils was by Dr. J. S. Bowerbank, F.R.S., a city merchant, who in 1840 published the first part of an incompleted work. Despite the fact that his identifications were largely incorrect, Bowerbank's contribution is described as "one of the masterpieces of palæobotanical literature". More recently compiled lists, notably those by the late Baron Ettingshausen, have little value. Most of the material described in the present work is from the Bowerbank Collection, purchased by the Museum in 1865, also the Reid and Chandler and Jenkins Collections, both of which were presented to the Museum. With very few exceptions the fossils are seeds and fruits, and these, at the hands of the two leading experts in a most difficult line of research, have yielded up the secrets of their structure, their affinities to existing species, and in many instances even the manner of germination. It has been clearly demonstrated that seeds and fruits are more trustworthy records than leaves or other parts of plants.

In the introduction the authors give an account of their methods of attack; they discuss the relative importance of various diagnostic characters, and state reasons for referring certain species to extinct rather than to existing genera. Tables are given showing the geographical distribution of living representatives of the London Clay genera, and the flora is compared with others of earlier and of later date. Special attention is given to the value of fossil plants as guides to climate, and apt quotations from descriptions of tropical forests facilitate reconstruction of those which were the source of the fossil material. These and other topics of general interest are handled with conspicuous ability and with impartiality. Excluding the diatoms recorded in 1881 by Shrubsole and Kitton, 234 species are described under specific names in addition to eight species *incertæ sedis*: the named species include one *Chara*, six conifers, and sixteen monocotyledons; the rest are dicotyledons, and not a single one is considered to be identical with a living plant. The flora is composed almost entirely of woody plants (ninety-seven per cent): all the species are believed to be extinct: of ninety well-founded genera, twenty-five are recent, sixty-five extinct. One of the many problems to be solved was the degree of importance to be attached to peculiarities in structural features in deciding whether or not the differences between the Tertiary and recent species were or were not beyond a range of variation which might be expected within a single genus. Comparison of many of the fossils with their living representatives also added new links to evolutionary series.

The London Clay families are mainly, or in part, tropical: five are exclusively tropical, fourteen are almost confined to the tropics, twenty-one are equally tropical and extra-tropical, and five temperate. A striking fact is the close relationship of the fossil species with plants that are now living in "the very heart of the East Asian Tropics", mainly in Malaya. There is very little relationship with Europe, West Asia, America and Africa. Statistics based mainly on fruits and seeds from later Tertiary floras show a gradual transformation of the flora of the London Clay into floras that are definitely European. The early Tertiary vegetation represents a stage when the climate of western Europe was warmer than at any subsequent period.

It has long been assumed that the animal and plant fossils of the London Clay indicate a tropical climate. Mrs. Reid and Miss Chandler, after discussing the opinions of some other palæobotanists that the value of fossil plants as criteria of climate has been over-estimated, give their verdict in favour of the more generally accepted belief that, if a flora is considered as a whole, it is a trustworthy index of climatic conditions. In criticising

the view that in the passage of time plants may have changed in their reactions to climate, the conclusion is reached that we have no evidence of greater power of adaptability in the past than at the present day. The facts cited, though they support this view, scarcely constitute a fatal objection to the possibility—a possibility which cannot be proved—that plants have suffered a constitutional change in the course of many million years rendering them more sensitive to the effects of climate. The conclusion is that the mean annual temperature in the area now occupied by the London Clay was about 70° F.

The authors believe that many of the London Clay plants were derived from early Tertiary forests in Malaya: the close resemblance of the western European Eocene flora with the present flora of Malaya may be regarded as an established fact, but this does not necessarily imply a Far Eastern source for the London Clay flora. It is conceivable that when the Malayan genera existed in western Europe they had not reached the Malayan region. We have little exact information on the Tertiary flora of Malaya; the correctness of the authors' conclusion that the London Clay plants were wanderers from the place where their present-day descendants are living may be questioned.

The authors dismiss Wegener's hypothesis of continental drift and shifting poles as inapplicable to the established facts of plant distribution in the Tertiary and Quaternary periods. If the gradual drifting apart of America and Europe occurred as Wegener supposed, one would expect a closer relationship of floras on the two sides of the Atlantic ocean in the earlier stages of continental separation: the evidence points in the opposite direction. It may, however, be suggested that continental drift did not follow the routes postulated by Wegener: the failure of one form of drift does not necessarily invalidate the idea of a mobile crust. The authors believe that the solution of the problem can be found by altering the distribution of sand and sea in accordance with the hypothesis of Dr. C. E. P. Brooks and by assuming changes in solar radiation.

The publication of this admirably illustrated volume, embodying the results of seven years' work, is a notable event for which many readers will be grateful to the Trustees of the British Museum and to Dr. Lang, the Keeper of the Geological Department; it is a fitting recognition of the splendid services rendered to botanical and geological science by two workers whose pre-eminence in a particularly difficult and exacting branch of research is acknowledged by their palæobotanical colleagues. A welcome supplement to the present work would be a paper illustrated by a few maps and a table of Tertiary and post-Tertiary plant-bearing series giving a general account of the gradual transformation of floras and the wanderings of plants since the dawn of the Tertiary period. A. C. SEWARD.

Philosophy of Life

Religion and the Sciences of Life: with other Essays on Allied Topics. By William McDougall. Pp. xiv+263. (London: Methuen and Co., Ltd., 1934.) 8*s.* 6*d.* net.

THERE is an orderliness, a vigour and a sense of conviction about everything which Prof. McDougall writes, which secure a ready attention from his readers and often actually influence one's opinion. This is the case with more than one topic treated of in the present volume. The author tells us that the first essay, which gives its title to the book, contains the thread of thought connecting the whole; it is necessary therefore to state that a little more fully than the rest. It is this. Whereas as a youth he was an ardent student of Darwin, Spencer and other 'agnostic' writers, in later life he has advanced to a more 'religious' position, coming to think that the 'spiritual' in man has an independent existence and value, and is capable in various measures of subjugating the material aspects of the world. This is the starting point; but he goes further and asserts that in these spiritual experiences man makes contact with a real and supremely important aspect of the universe, in which he shares, being influenced by it and in return contributing something.

It will be seen that in these short pages—the essay only runs to sixteen—Prof. McDougall succeeds in raising and summarising in very effective form some of the deepest philosophical questions. It is equally clear that they cannot be adequately discussed in the few lines of a review, and we would here only note them, and note also that he seems to have come to his change of mind chiefly from meditating on the æsthetic aspect of man's activity, and that the two thinkers who have personally most influenced him are the late Poet Laureate in England and M. Bergson in France.

It is easy to understand how this religious or philosophical progress has been bound up in the author's mind with the special lines of scientific inquiry which have interested him, and which form the bulk of the essays in this volume. It is clearly akin to the form of vitalist doctrine which appeals to him. If we connect the 'spiritual' element in man's nature with that which manifests itself in all living things leading up to man, we must postulate this to be of some distinct and intrinsic value, above the physical and chemical changes which we observe in the inanimate. It is also bound up with the work of the two societies of which Prof. McDougall tells us he is an active member—he thinks the only active person belonging to both. These are the Eugenics Society and the Society for Psychical Research of which he has been the president in America, actually founding that in Boston. To find out by scientific methods the nature of the spiritual element is very properly his leading interest; and he adds to this the equally strong practical passion to increase by eugenic methods the number of efficient individuals by whom the spiritual element in the world may be transmitted and increased. His two essays on this topic, and his cogent argument for distinguishing between the eugenic and dysgenic forms of family allowances, are perhaps the part of the book which will seem to call for most immediate and detailed consideration.

On another side of his subject we know that Prof. McDougall feels strongly and will arouse a good deal of sympathy in philosophical circles; that is the need for more scientific psychology at the older universities. He urges this in an essay reprinted from the *Edinburgh Review* of 1927, and it remains substantially true at the present time. But there is one subject on which he is inclined himself to be a little less than philosophic, and that is 'race'. He often speaks, in discussing national characteristics, as if they were mainly to be connected with blood and actual descent, whereas the historian will be much readier to seek them in the historical or sociological environment by which the nation has been formed. The truth no doubt lies in a delicate balance of the two aspects; Prof. McDougall seems to tilt it somewhat on the 'racial' side which we now associate with 'Aryan' echoes.

It is almost needless to say that the book on the whole is highly stimulating and valuable.

F. S. MARVIN.

Studies in Heat

(1) *Heat.* By Prof. James M. Cork. Pp. xi+279. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 18*s.* 6*d.* net.

(2) *A Text Book on Heat.* By Dr. A. W. Barton. Pp. xiii+378. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 7*s.* 6*d.*

(3) *Heat* (*Matriculation Standard*). By Robert W. Hutchinson. Pp. vii+266. (London: University Tutorial Press, Ltd., 1933.) 3*s.* 6*d.*

(1) PROF. CORK'S treatise is essentially an advanced theoretical survey. Its scope can best be indicated by paraphrasing certain statements in the author's preface. The pioneer work of Fourier in attacking thermal problems gave solutions from which other branches of the science such as electricity and magnetism were able to profit, and the introduction of the quantum in the theory of radiation was the basis of remarkable advances in many related fields. The presentation of this newer matter together with the older classical treatment widens the scope and range of material of an adequate text surveying the whole scheme. The book aims at covering in a not too detailed manner the complete development of the subject.

Such an ambitious scheme in a book of this length obviously involves drastic condensation. Working descriptions of classical experiments are either omitted or indicated only in outline, and the same may be said of practical laboratory experiments; the book not being intended as a practical course, such experiments are only referred to or suggested.

The volume would form a good adjunct to an advanced course of lectures; it certainly has the merit of being complete rather than detailed, and contains information on almost everything which a reader could reasonably require; the presentation brings out clearly the connexion of the subject with physical chemistry and allied branches of science. To offset the condensation, very full references are given to original papers to which the student is expected to refer. A competent mathematical equipment is naturally assumed, if only to bridge the steps in the deduction of important relations and formulæ, and these again can be studied in detail, as the requirements of the reader dictate, from papers or special sources. Important recent work is included; the two concluding chapters deal with the production of high

and of low temperatures ; seven out of the remaining nine chapters end with a set of questions and problems, and an appendix of 14 pages gives tables of constants and numerical data.

(2) Before attempting a survey such as that referred to above, the student can be confidently recommended to Dr. Barton's textbook which, as the author states, has been written to satisfy the needs of those reading for university entrance scholarships and various Higher School Certificate and university intermediate examinations. At the same time, the subject is treated so as to show that the study of a branch of natural science may be genuinely cultural. To this end the scientific method and the development and "appreciation of the beauty of the rational scheme which has been created by the mind of man to explain the phenomena of Nature" are kept to the fore throughout.

With regard to the scope of the work, in addition to the form of presentation of the more elementary topics to be expected in an intermediate textbook, chapters are devoted to the kinetic theory of gases, Van der Waals' equation, cyclical operations and adiabatic changes, and the laws of thermodynamics. The possibilities of the quantum theory are hinted at in places, but are not actually introduced. The order adopted is justified in the introduction, which gives a striking logical development of the aspects of the subject, and which a student of the book should on no account omit to read. The following commendable features of the text are especially evident : new practical methods are given, historical presentation is adopted but much historical dead-weight is omitted, and the mathematical treatment is entirely up to date and extremely clear. The whole text gives a general impression of efficiency and completeness without attempting to be exhaustive, and this impression is supported by the adoption of a uniform and readable style of printing, together with diagrams well above the average in quality and clearness. In subsequent editions the index might be made considerably more detailed.

(3) The well-known style of the Tutorial Press textbooks is preserved in this thoroughly sound introductory course. While the conventional order and treatment is followed, improved practical methods and apparatus are introduced, and special attention is given to modified versions of classical experiments which can be performed by students with simplified but effective devices. It is satisfactory to note the inclusion, among others, of short sections dealing with platinum resistance thermometers and thermocouples, the equilibrium of balloons as an illustration of a practical application of the gas laws, the determination of the calorific value of fuels, and an electrical method of finding the latent heat of vaporisation of a liquid.

N. M. BLIGH.

Short Reviews

The Birds of Tropical West Africa : with Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria. By D. A. Bannerman. (Published under the authority of the Secretary of State for the Colonies.) Vol. 3. Pp. xxxv+487+12 plates. (London : Crown Agents for the Colonies, 1933.) 22*s*. 6*d*.

WITH the issue of the third volume of Mr. Bannerman's great work, sponsored by the Secretary of State and by the Colonial Governments in West Africa, the project is half completed. In this volume we find the representatives of such cosmopolitan orders as the owls and the swifts, side by side with those of such purely African groups as the plantain-eaters and the mousebirds ; or we may contrast the rollers and the hoopoes, ranging widely in the Old World, with the trogons, discontinuously distributed in tropical forests from South America to Malaya. The representation is often large : for example, twenty-four species of owls and thirteen of kingfishers within the area, and sub-species as well.

The information given for each form includes a description of it and a note on its identification in the field : this is done even for familiar European species occurring as migrants, so that the work serves as a complete guide for the observer on the spot. There follows a summary of the available information as to the range, local distribution and habits of the bird, and although the data under these heads are often of necessity very meagre, they should provide both a basis for further work and an incentive to its undertaking. Questions for elucidation are abundant : the predatory methods of the fishing-owls do not seem to have been observed ; the 'indicator' behaviour of the honey-guides is proved only for one species ; the strange nidification of the hornbills is worthy of further study ; and knowledge of the migrations of the different nightjars rests upon scanty records.

The illustrations deserve special praise. The principal artist is Mr. Henrik Grönvold, but there are also coloured plates by Mr. G. E. Lodge and the late Major Henry Jones. If one may be singled out for mention, Mr. Lodge's group of bee-eaters—five species vying with each other in the varied brilliance of their plumage—is a thing of beauty.

Publications du Bureau d'Études géologiques et Minières coloniales. *Les ressources minérales de la France d'outre-mer.* 1 : *Le charbon.* Pp. iii+245. 24 francs. 2 : *Le fer, le manganèse, le chrome, le nickel, l'étain, le tungstène, le graphite, le glucinium, le molybdène, le cobalt, le titane, le vanadium.* Pp. iii+436. 36 francs. (Paris : Société d'Éditions Géographiques, Maritimes et Coloniales, 1933–34.)

THESE two volumes form part of a series the aim of which is to make better known the geology and mineral resources of the French colonies. A preliminary volume, "La géologie et les mines de la France d'outre-mer", was noticed in NATURE last year (vol. 131, June 10, 1933). It was of an introductory nature, and dealt with each colony in turn, emphasising more particularly the geology of these scattered colonies. In the volumes under notice the plan differs, each material or element being treated separately. The general scheme is as follows. An adequate account of the geology of each deposit is given, illustrated by sketch maps and diagrams. This is followed by a description of the nature of the ores and the forms in which they generally occur. In volume 2, which deals with iron and metals important in the metallurgy of iron and steel, the uses and metallurgy of the several metals are discussed. Finally, with the aid of up-to-date statistics as to production, consumption and markets, the present importance and future possibilities of each deposit are summarised. Comparative descriptions are also given of world deposits other than those of the French colonies.

Many of the deposits described are at present comparatively unimportant commercially. Nevertheless, to the geologist and mining engineer the volumes are definitely interesting, since they furnish descriptions, with bibliographies, of the geology and ore deposits of a number of little-known countries, the literature of which is otherwise relatively inaccessible.

To the economist and politician the importance which some of these deposits might assume in the event of another world war may not be without interest.

The Problem of the Twentieth Century : a Study in International Relationships. By Lord Davies. New and revised edition. Pp. xvii+819+2 plates. (London : Ernest Benn, Ltd., 1934.) 21*s.* net.

IT is encouraging to find that a second edition of this masterly book has been called for, and for an estimate of its general content and purpose we must refer to the review of the first edition published in NATURE on January 17, 1931. The three years which have elapsed since then have only added to the urgency of the problem discussed, while they have given Lord Davies the opportunity of urging his solution in the House of Lords, where he spoke with the cordial though guarded sympathy of Lord Cecil and the other friends of the League of Nations and international peace. The three years since the first edition have added to the difficulties of disarmament the fresh menace of a now triumphant Nazi party in Germany. Germany has left the League of Nations because she will not submit to gentle control. Is she more likely to return, if it is armed, on Lord Davies's plan, with all the resources of scientific warfare ? We allude to these things not in a spirit hostile to the book, which is an admirable summary, historical, political and technical, of the whole question of the international prevention of war, but only to show the extreme and recently increasing difficulty of applying the solution of an international police force. The most hopeful line would seem to be that indicated by Lord Cecil in the debate in the House of Lords. Concentrate on the control of the air, a sphere which is most clearly international and in which our means of action are most modern and scientific. F. S. M.

Catalogue of the Books, Manuscripts, Maps and Drawings in the British Museum (Natural History). Vol. 7 : *Supplement J—O.* Pp. iv+513–967. (London : British Museum (Natural History), 1933.) n.p.

WITH this volume more than half the task of cataloguing the "supplementary" works in the Library of the Natural History Museum at South Kensington is completed. No information is given as to the period covered by this supplement, but in its earlier part it includes works published up to 1923 and in its later part to 1931. In addition, there are works of an earlier period—such as the majority of the entries under the heading of "Linnæus (Carl)", which form a valuable classified index to writings by or about the great botanist, occupying 91 pages of the book. The type is clear, the bibliographical work of the high quality which readers have come to expect in these volumes ; the book will be valued as a guide to a great library of natural history, and as a general index to the natural science publications of its period.

Introduction à l'étude de l'effet Raman : ses applications chimiques. Par Prof. Pierre Daure. Pp. viii+90. (Paris : Éditions de la *Revue d'Optique théorique et instrumentale*, 1933.) 18 francs.

THIS little work gives a brief and simple, but extremely clearly written account of "one of the greatest gifts bestowed by physicists upon chemists". The five chapter headings are : molecular diffusion and the Raman effect ; technique ; application of the spectra to chemical analysis ; interpretation of Raman spectra ; and examples of chemical application. Attention is thus fairly apportioned between the practical and theoretical side. Photographs of Raman spectra are well reproduced. The examples are almost wholly confined to organic substances, and the extensive contributions made by research workers in India and the United States with the help of this rapidly developing physical weapon are almost untouched. N. M. B.

Geochemistry of Living Matter

THE chemical composition of living organisms has been studied in the past by many scientific investigators, but not in a systematic way. A new and thoroughly comprehensive approach to the investigation of the whole problem can be seen in the work of the Biogeochemical Laboratory of the Russian Academy of Sciences, under the inspired leadership of Prof. V. I. Vernadsky, whose fundamental idea is to study living matter not as something apart from so-called inorganic Nature, but as an important participant in the extremely complex chains of the geochemical processes proper to our planet. E. Suess already in 1875 proposed the term 'biosphere' for that portion of the earth's crust which contains life[1], but no attempt has ever been made to investigate the extent to which the multitudinous 'rocks' of the earth's crust are influenced by living organisms. Vernadsky is convinced that the geochemical rôle of organisms is grossly misunderstood and underrated. This fascinating problem was raised by him[2] so far back as 1918, and in 1928 a special laboratory was created for the purpose of investigating it. The enormity of the task before the laboratory makes it impossible to expect any far-reaching results within such a short period, but two reports[3,4] and a series of papers published from the laboratory contain a mass of valuable data, which can be only very briefly reviewed here.

One of the first problems before the laboratory is the quantitative investigation of the chemical composition of living organisms. In this direction, apart from card-indexing all the existing scattered information, some important data have been obtained on the fresh-water plankton (Vinogradov[3]), on a number of insects (Bergman[4]; Vinogradov[5,6]), on Echinodermata (Terent'eva[4]), etc. A general survey of this problem has been presented by Vinogradov[6,7], who points out that the data, mostly very fragmentary, exist with regard to the elementary chemical composition of only about five thousand species of plants and two thousand species of animals, which is less than 0·5 per cent of the known species. Sixty of the chemical elements have already been found in living organisms, and there are good reasons to expect that the remaining ones will also be discovered in them.

The chemical composition of various organisms is very similar with regard to such elements as carbon, nitrogen, sulphur, phosphorus, hydrogen and oxygen, but the quantity of others, such as iron, manganese, iodine, bromine, arsenic, boron, titanium, vanadium, etc., is subject to great variations from species to species. Certain organisms can be regarded as accumulators of definite elements; for example, ants accumulate manganese (Vinogradov[5,6]), Lycopodiaceæ accumulate aluminium, etc. An extremely interesting graph constructed by Vinogradov demonstrates that the chemical composition of living matter can be regarded as a periodic function of the atomic weights of elements, and the periods go mainly in sixes, so that every sixth element has a special importance for organisms. Further, it appears that organisms most ancient geologically (such as bacteria, Foraminifera, etc.) are able to concentrate a much wider range of elements, while the range of elements concentrated by the highest modern organisms (Aves, Mammalia) is very much restricted.

Another point of interest is the conclusion reached after a study of several species of *Lemna*, which proved to possess each a definite chemical composition, while the variation within each species was very small (Vernadsky and Vinogradov[9]). Hence it appears probable that the quantitative chemical composition is a specific character. Further, important data have been obtained on the presence in organisms of certain rare elements. Thus, vanadium proved to be present in some plants, but in much more appreciable quantities in Ascidia (Vinogradov[4,10]); the rubidium content of the plants *Suaeda maritima* and *Salicornia herbacea* growing on the shores of the Sea of Azov proved to be of the same order as that in the water of that sea (Burkser and others[4]). Special attention was paid in the laboratory to the concentration of radium by various species of *Lemna*, and it was found that the radium content of the water in which they grow decreases in spring when the plants show a rise in radium content; in autumn when the plants die off, radium from them again returns into the water (Brunovsky[3]; Vernadsky[11]). The problem of the carbon content in animals was studied in Acrididæ by Kunasheva[4], and some indications obtained with regard to the changes connected with the species, sex and the stage in the development. The chemical changes connected with metamorphosis in insects were investigated by Bergmann[4] in a series of species.

Another problem studied by the laboratory is the determination of atomic weights of elements obtained from living organisms. Already in 1926 Vernadsky[12] put forward a hypothesis that living organisms should possess a selective power between isotopes of an element, so that an element obtained from them should not contain a mixture of isotopes as is the case with the many elements in inorganic Nature. Technical difficulties connected with the organisation of these investigations do not yet permit the attainment of any definite results, but in the meantime Loring and Druce[13] have shown that in the potassium from potato the isotope of atomic weight 41 predominates; in ordinary potassium the chief isotope, of course, is of atomic weight 39. In the Biogeochemical Laboratory, work is in hand on the atomic weights of potassium in peas and beans, and of uranium in various organisms.

The geochemical rôle of living organisms is

obviously closely connected with the rate at which the organisms are able to assist in the migration of chemical elements in the biosphere. This rate, or the geochemical energy of living matter, depends on several specific properties of the organisms, namely, the average weight, the volume and surface of the individual, the rate of reproduction and the rate of dispersal over the earth's surface (Vernadsky[14]). Special methods have been elaborated by the Laboratory for the determination of these constants (Vernadsky[15]; Cholodovskij[3,4]).

Since the fundamental idea behind all the studies which have been directed by Prof. Vernadsky is to understand in a quantitative way the whole immensely complex series of processes connected with dynamic biogeochemistry, it is only natural that some of his publications represent attempts at building up comprehensive theories. Here belongs, first of all, his profoundly philosophical treatment of the whole problem of the biosphere[1], which one would like to see republished, since in the last few years a great number of new facts has been accumulated, and many hypotheses can be either substantiated, or modified. Another remarkable work is the history of natural waters[16], where 485 'species' of water occurring in Nature are distinguished and classified according to their genesis and properties. A general discussion on the geochemical problems in oceanography[17] represents another brilliant summary of a very difficult subject.

Scientific workers who prefer definitely ascertained facts to far-reaching hypotheses may argue that the time is not yet ripe for an all-embracing treatment of living matter as a factor in the history of our planet. No one, however, after acquainting himself with Prof. Vernadsky's work, will be able to doubt that such a treatment is not only thoroughly scientific, but also is already yielding important results bearing a promise of establishing surprising interrelations between the so-called inorganic and organic worlds. It is a matter of deep regret that most of the publications by Prof. Vernadsky and his school are in a language which prevents his views from becoming more widely known amongst biologists, chemists and geologists, for all of whom they open new and promising fields of study.

B. P. UVAROV.

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[3] *Travaux du Labor. Biogeochem. Acad. Sci. U.R.S.S.*, **1**; 1930.
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[6] *C.R. Acad. Sci. U.R.S.S.*, 227; 1929: *ibid.*, 127; 1930.
[7] *C.R. Acad. Sci. Paris*, 1673; 1933. *Priroda*, No. 8–9, 1933; 1933.
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[9] *C.R. Acad. Sci. U.R.S.S.*, 148; 1931. *C.R. Acad. Sci. Paris*, 560; 1931.
[10] *C.R. Acad. Sci. U.R.S.S.*, 465; 1930.
[11] *C.R. Acad. Sci. Paris*, 421; 1930.
[12] *C.R. Acad. Sci. U.R.S.S.*, 215; 1926. *C.R. Acad. Sci. Paris*, 131; 1931.
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[14] *Bull. Acad. Sci. U.R.S.S.*, 697, 727, 1053; 1926.
[15] "Instructions for the Determination of Geochemical Constants." Publ. Acad. Sci. U.R.S.S., 1926, 2 parts.
[16] "History of the Minerals of the Earth's Crust", vol. 2. "History of Natural Waters", part 1 (in Russian). Leningrad, 1933.
[17] *Miner. und Petrograph. Mitteil.*, **44**, 168; 1933.

Origin and Nature of the Association between Invertebrates and Unicellular Algæ

By PROF. C. M. YONGE, University of Bristol

THE widespread occurrence of zoochlorellæ or zooxanthellæ within the tissues of invertebrates is now universally recognised, the extent of knowledge on this subject up to 1930 being well summarised by Buchner[1]. Nevertheless the actual nature of this association, or rather of the many forms which this may take and the connexion between these, is greatly in need of clarification. It is unfortunate that of the many workers in this field none, save Brandt, one of the earliest, has studied conditions in more than one or two groups. My own work on the comparative physiology of digestion and on symbiosis between zooxanthellæ and Anthozoa and Mollusca, together with a critical examination of recent, largely experimental, work on this type of symbiosis, has enabled me to throw some light on the origin and nature of this association.

Association with unicellular algæ is almost certainly confined to animals which digest intracellularly. This has been suspected by many workers, but confirmation has had to await the full elucidation of the conditions of digestion throughout the invertebrates (see Yonge[2] for a summary of the present state of knowledge). Unicellular algæ occur in Protozoa, Porifera, Cœlenterata, Ctenophora, Turbellaria, Rotifera, Gastropoda and Lamellibranchia, all of which digest intracellularly. The conditions both of symbiosis and of digestion in Polyzoa and Echinodermata require further investigation. Zooxanthellæ do occur in compound Ascidians from tropical seas as recorded, for example, by Hastings[3] in a number of species collected by the Great Barrier Reef Expedition, but Mr. H. G. Smith, to whom I recently gave these for examination, finds that the algæ are confined to the common test and never occur in the actual tissues. Berkeley[4] has recently definitely established that a green flagellate occurs in the Chætopteridæ which, like all Annelida, digest extracellularly. The work of Wilson[5], who found indications of intracellular digestion during the metamorphosis of *Owenia*, affords a possible explanation of the origin of this association.

A survey of the animals which contain algæ reveals that some of these are carnivores, notably the Cœlenterata, the Turbellaria and those Gastropoda which harbour algæ, while the others are omnivorous or definitely herbivorous, such as the Protozoa, Porifera and Lamellibranchia. The association with algæ would appear to have arisen in different ways in these two groups.

In the carnivores (Cœlenterates, in particular, are such specialised carnivores that they will neither accept nor ingest plant matter) the association was originally probably one of parasitism by the plant. This is strongly indicated by the very beautiful work of Gœtsch[6] on the association of algæ (Chlorellæ) with the Hydrida. *Pelmatohydra* and *Hydra circumcincta* never contain algæ. Spontaneous infection by algæ has been observed in *Hydra vulgaris*, and Gœtsch was able to bring about artificial infection and maintain this so long as conditions remained suitable for the algæ, which were, however, confined to certain parts of the body. In *Hydra attenuata*, artificial infection was easier, and the algæ spread more extensively throughout the tissues, becoming increasingly difficult to dislodge as time passed. Finally, according to Gœtsch, they so affect the tissues of the host animal as to form a new race, *Hydra viridescens*, where the association may be regarded as a true symbiosis. In both *H. vulgaris* and *H. attenuata*, infection is preceded by an enfeeblement of the animals and is accompanied by pathological symptoms indicating a definite parasitism by the plant. In *Chlorohydra viridissima*, there is a permanent and normal association with algæ, which are extremely difficult to remove experimentally from the tissues, the colourless animals so obtained being very easy to reinfect and actually taking in other algæ (*Oocystis*) if Chlorellæ are not available. In *Chlorohydra* alone are the algæ transmitted from generation to generation by way of the egg.

Gœtsch's work probably gives the key to the final establishment of symbiosis between carnivorous animals and algæ. An initial stage of parasitism by the plant is followed by the establishment of tolerance by the animal and later, as in *Chlorohydra*, the algæ are normally always present. Nevertheless, as Gœtsch and Van Haffner[7] have shown, *Chlorohydra* can, under appropriate conditions, flourish when deprived of the algæ. Van Haffner has shown that very similar conditions prevail in the freshwater Turbellarian, *Dalyellia viridis*. Further examination of conditions in the Cœlenterata and the Turbellaria reveals that one of two things may happen. The animal may become dependent on the plant, which still remains capable of an independent existence, or the plant becomes dependent on the animal, being specialised exclusively for life within its tissues, while the animal continues to feed normally.

The first of these alternatives is exemplified in the well-known case of *Convoluta roscoffensis* (Keeble and Gamble[8]) where the animal finally ceases to collect food and preys on the contained algæ which, though they become modified within the tissues of the animal, are members of the free-living genus *Carteria*. *Convoluta paradoxa* (Keeble[9]) occupies an intermediate position between *Dalyellia* and *C. roscoffensis*. The second alternative is exemplified by conditions in the reef-building corals (Yonge and Nicholls[10,11]) where the zooxanthellæ are never found free in the sea, have apparently lost the capacity for sexual reproduction, and have acquired a very thick cellulose wall. The animals are not only capable of feeding normally, but actually display all manner of adaptations for this. They certainly *never* digest the zooxanthellæ. Similar conditions probably prevail throughout the Anthozoa (and possibly the Scyphozoa), the opposite conclusions of Brandt[12] for anemones being open to question (his results are being reinvestigated).

Turning to the origin and establishment of symbiosis in herbivorous animals, the best indication of the preliminary stages appears to be furnished by the work of Van Trigt[13] on the Spongillidæ. Here the algæ (*Pleurococcus*) are taken in by the collar cells and passed into amœbocytes. Under favourable conditions they maintain themselves for a time but, should other food fail, they are quickly digested. The algæ are apparently capable of no more than prolonging existence for some time under conditions in which other algæ are immediately killed and digested. An increased resistance to the digestive activities of the animal may well have led to the establishment of conditions such as those recorded by Pringsheim[14] and Parker[15] in *Paramecium bursaria*. Here a very well-balanced condition has been established, the infected animals being capable of existing in the light autotrophically for a long period, so long as the necessary nutrient salts and calcium are present. Only in extreme cases are the algæ digested by the animal, which is, however, capable of living without them, feeding on algæ, bacteria and especially yeasts.

Symbiosis may also be established by the transference of an alga, already specialised for such an existence, from one type of animal to another. Naville[16] has recorded the interesting case of the Nudibranch, *Æolidiella alderi*, which feeds exclusively on the Actinian, *Heliactis bellis*, which contains zooxanthellæ. Not only are the nematocysts in the cerata of the mollusc identical with those of the anemone but also the same zooxanthellæ flourish in the ingesting cells of the 'hepatopancreas'. The zooxanthellæ in the test of compound Ascidians (which appear to be identical with those of corals and other reef-dwelling Anthozoa) may well be derived in the first place from those contained in planulæ, being in some manner incorporated in the common test during the growth of this. In the Tridacnidæ, where is found one of the most striking cases of dependence by animals on contained algæ, the animal literally 'farming' the plants in the thickened mantle edges (Yonge[17]), the zooxanthellæ may also in past time have been acquired from planulæ.

A study of the nature of the association as it exists in different animals at the present day reveals, as the foregoing account has already indicated, many gradations. This can most conveniently be reviewed by discussing first the possible advantages gained by the algæ and then those gained by the animals.

The algæ obtain protection once they have succeeded in establishing themselves. They obtain

ample supplies of carbon dioxide, which would probably always be available, but, more important, also of nitrogen and phosphorus. Many of the early workers in this field emphasised the significance of 'nitrogen hunger' in the sea, but this is no more important, as we now know, than 'phosphorus hunger'. In the reef-building corals, not only is all the phosphorus liberated by the animals immediately utilised by the zooxanthellæ, but phosphorus is also taken from the surrounding water even though the content has been artificially increased to a very high figure (Yonge and Nicholls[10]). The algæ in *Convoluta* can utilise uric acid or urates, but these algæ when living free in the sea may normally feed saprophytically.

In other cases also the algæ appear capable of existing to some extent saprophytically within the bodies of the animals. Thus Pringsheim has found that the Chlorellæ in *Paramecium bursaria* not only survive but also may actually increase in darkness, provided that the animals are well fed. Since the algæ cannot photosynthesise under these conditions, it is clear that they must obtain organic matter from their hosts. Van Haffner has come to similar conclusions in his work on the Chlorellæ contained in *Chlorohydra viridissima*. He states that they may increase in darkness and that they are always especially numerous and increase most rapidly in those regions of the animals where carbohydrate is most abundant. In correlation with this tendency to saprophytic nutrition he finds that the Chlorellæ within the animals have smaller pyrenoids than those which are free-living. The conditions here, therefore, are somewhat akin to those in *Convoluta roscoffensis*.

The advantage which the association brings to the animals also varies very greatly in different cases. In the presence of light, oxygen is continually being formed by the algæ. In corals and other Anthozoa this may, during the middle of the day, be greatly in excess of the amount used by the animals and plants in respiration (see Yonge, Yonge and Nicholls[18]). But it is noteworthy that few workers, though all have mentioned the production of oxygen, lay much stress upon it. Though it has been proved in many instances that, under experimental conditions, 'green' animals will survive for longer periods in deoxygenated water in the light than will 'colourless' animals of the same species, yet it is almost universally admitted that such conditions would seldom, if ever, be encountered by the animal in Nature.

There is also universal agreement that the plants make use of the end-products of animal metabolism, notably carbon dioxide, nitrogen and phosphorus, and that this automatic removal of excrement may be of great advantage to the animal. There can, as already stated, be no doubt that this occurs, though its actual significance in the life of the animals is more difficult to assess. In *Convoluta roscoffensis* and *C. paradoxa* its great significance is placed beyond question by the absence in these animals of organs of excretion. In Protozoa, Porifera and Cœlenterata organs of excretion do not occur, so that this test cannot be applied. I have previously summarised in NATURE (Yonge[19]) my reasons for thinking that, though individual corals can live well without contained zooxanthellæ, yet, because of the help they give by automatically removing the end-products of metabolism, the zooxanthellæ are "probably an indispensable factor in the necessarily exceptional powers of growth and repair possessed by the marine communities known as coral reefs".

The most disputed point of all is the extent to which the algæ provide food to their hosts. The animal may obtain food from them in one of three ways. In the first place, organic matter (notably fats and carbohydrates) may pass from the living algæ to the tissues of the animal. Pringsheim has shown that this must be the explanation for the autotrophic mode of life possible to green *Paramecium bursaria*. Brandt[20] came to similar conclusions in his work on colonial Radiolarians, stating that starch passes from the living zooxanthellæ into the protoplasm of *Sphærozoum*, *Acanthometra* and *Siphonosphæra*. Famintzin (quoted by Buchner), on the other hand, thought that this starch was derived from degenerating algæ. This matter requires, as Buchner has observed, further investigation. In *Chlorohydra* Gœtsch has shown that green individuals will survive starvation in the light for about four months, whereas colourless individuals live for only half this time. He inclines to the view that organic matter, in particular fat, is passed from the algæ to the animal under such conditions, but Van Haffner comes to the opposite conclusion both for *Chlorohydra* and *Dalyellia*. He does think, however, that degenerating algæ may be used as food by the animal. In *Convoluta roscoffensis* and *C. paradoxa* there is an undoubted passage of fat from the algæ to the tissues of the animals, during the early stages of the association. Keeble and Gamble have figured the process and I have myself prepared sections of *Convoluta roscoffensis* which confirm their statements.

The second alternative is that the animals digest the algæ after these have, for some reason or other, probably starvation, died in the tissues. Van Haffner is the only author who has laid great stress on this, but it may be of considerable significance. It does not, however, follow that a degeneration of the algæ necessarily means that they are digested; for in corals, degenerating algæ are continually being ejected from the body of the animal by way of the mesenterial filaments (and the process can be very greatly increased by subjecting the corals to excessive heat, lack of oxygen or starvation) but these are *never* digested. A starved coral will live no longer in light than in darkness (Yonge and Nicholls[11]).

Finally there remains the possibility that living algæ are killed and digested by their hosts. In extreme cases this occurs, according to Pringsheim, in *Paramecium bursaria*. In the Spongillidæ it continually occurs, as Van Trigt has shown, while I have found that it is an equally normal process

(and a more essential one) in the Tridacnidæ. But all of these animals are naturally herbivorous and the powers of resistance to digestion by the algæ are limited, particularly in the Spongillidæ. In *Convoluta roscoffensis* and *C. paradoxa* the algæ are certainly digested, the former species finally losing the power of feeding altogether, and becoming completely parasitic on its contained algæ. This appears to be the only case of an animal which becomes completely dependent on the algæ for nutrition.

Several points of interest emerge from this discussion on the possible food value to the animals of the algæ. One is that in herbivorous animals the power to resist digestion by the animal entails specialisation on the part of the algæ (for example, in *Paramecium bursaria*); another is that the ability to feed on the algæ represents a specialisation on the part of the carnivorous animals such as *Convoluta*, though in this case the absence of a cellulose wall around the algæ is possibly of significance. The presence, on the other hand, of an exceptionally stout cellulose wall around the zooxanthellæ of corals and other Anthozoa possibly explains the inability of such animals to obtain nutriment from these even after they have died in the tissues. In *Tridacna*, where the zooxanthellæ are otherwise very like those of the corals, I have been unable to find so thick a cellulose wall. The passage of organic matter from the algæ to the host, as in *Paramecium* and *Convoluta*, probably involves specialisation by the plants, but it also indicates that these are in a position to produce more food than they need themselves for maintenance and multiplication. In the corals the endoderm is invariably packed with zooxanthellæ (as many as 25,000 may occur in a single planula of *Pocillopora*) and these increase as the coral grows. There is never likely to be any superfluity of food under these conditions; indeed, as already stated, the zooxanthellæ will extract phosphorus from the surrounding water.

This summary will have indicated, if nothing else, that the nature of the association between animals and unicellular algæ varies greatly in different cases. If by symbiosis is meant only a relationship which is mutually advantageous to both parties, then the only adequately investigated cases which meet this requirement are *Paramecium bursaria*, *Chlorohydra* and the reef-building corals (and probably all Anthozoa). In every other instance, one party in the association is exploited in some measure by the other.

In conclusion, I wish to record my thanks to the Royal Society of London for a grant which has assisted the investigations from which many of these conclusions have been drawn, and also to Mr. H. G. Smith for kindly permitting me to mention the results of certain unpublished work.

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Obituary

PROF. A. P. CHATTOCK, F.R.S.

PROF. ARTHUR PRINCE CHATTOCK, emeritus professor of physics in the University of Bristol, died at his home in Clifton, Bristol, on July 1 at the age of seventy-three years. Educated at University College School, University College, London, under Carey-Foster, and at Stuttgart, he started his career as an electrical engineer in the firm of Siemens. In 1885, however, he was appointed as the first lecturer in physics in University College, Bristol. He spent the following year in Liverpool under Sir Oliver Lodge and then returned to Bristol to take up the duties of a newly created chair in this subject.

From 1887 until 1910 Prof. Chattock was known to a generation of students of physics at Bristol as an inspiring and self-sacrificing teacher, and to his contemporaries as an experimenter who, despite meagre facilities, carried out pioneer work of the first rank. Among these researches may be mentioned that on the mobility of gaseous ions, and the Chattock-Fry pressure gauge originally designed for the work of Stanton on the wind pressure on structures, and later incorporated in wind tunnel measurements. An ingenious magnetic potentiometer devised by him deserves notice, as also an attempt, though negative in result, to verify Weber's theory of electromagnetism.

The foundation of the University of Bristol in 1909 brought additional responsibilities to his office. Modest and retiring almost to a fault, Prof. Chattock felt that he could not face them, and to the great regret of his colleagues, both lay and academic, he retired from his post to live in the country. There he stayed for ten years, engaged in poultry farming and on work for the Ministry of Agriculture on the physics of incubation.

In 1920, however, Prof. Chattock was induced to return to the University laboratories for a few years under the terms of his emeritus professorship, with facilities for continuing his researches in physics. In this later period, he carried out with L. F. Bates a classical determination of the gyromagnetic effect in iron. This, coupled with later work by Bates and Sucksmith, and more recently on paramagnetic substances by Sucksmith in the

Bristol laboratory, has had important consequences in the study of modern physics. He was awarded the honorary degree of D.Sc. by the University of Bristol in 1911, and was elected a fellow of the Royal Society in 1920.

DR. T. G. PINCHES

WE regret to record the death of Dr. Theophilus Goldridge Pinches, the distinguished Assyriologist, which took place at the age of seventy-eight years, at Muswell Hill, London, on June 6. Dr. Pinches originally was engaged in his father's business as a die-sinker; but, taking up the study of cuneiform inscriptions, he joined the staff of the British Museum in 1878, retaining that position until 1900, when he retired on pension. He was lecturer in Assyriology at University College, London, and in the University of Liverpool, resigning the latter post, owing to ill-health, only a year or two before his death.

At the British Museum Dr. Pinches' work was especially noted for the beauty of his copies of cuneiform texts. He was responsible for the text of parts of vol. 5 of the "Cuneiform Texts from Babylonian Tablets" and "Cuneiform Inscriptions of Western Asia" published by the Museum; and he compiled a guide to the Nimroud Saloon. For many years, Pinches was one of the foremost workers among the group which included Sayce, Thureau-Dangin and Bertin. He was recognised as an expert in the Assyro-Babylonian and Sumerian languages and had studied Hebrew, Aramaic, Ethiopic and Arabic. He was especially active in connexion with the work of the Society of Biblical Archæology, the periodical publication of which contains a large number of contributions from him. He was also its editor. For some time he was a member of council of the Royal Asiatic Society.

A very long list of books, monographs and papers on Assyriology stands to Dr. Pinches' credit. He edited and translated the Amherst tablets (1908), the Berens Collection (1915), and the texts belonging to Sir Henry Peek (1888). He also contributed translations to "Records of the Past" (second series). One of his most interesting discoveries was the bilingual story of the Creation which was published in "The Old Testament in the Light of the Historical Records of Babylonia and Assyria" (1908). Among his works of a more popular character may be mentioned "Religion of Babylonia and Assyria" (1906).

WE regret to announce the following deaths:

Mme. Curie, professor of general physics in the Faculty of Sciences at the Sorbonne and director of the Laboratoire Curie at the Institut du Radium, Paris, known for her work with her husband, Pierre Curie, leading to the discovery of radium, and for subsequent researches on radioactivity, on July 4, aged 66 years.

Sir James Fowler, K.C.M.G., K.C.V.O., consulting physician to the Middlesex Hospital, formerly dean of the Faculty of Medicine, University of London, on July 3, aged 82 years.

News and Views

Honorary Members of the Royal Society of Edinburgh

ON July 2, the following were elected honorary fellows of the Royal Society of Edinburgh to commemorate the completion of its 150th year: *Foreign*, Björn Helland-Hansen, Geophysical Institute, Bergen; Prof. Bernardo Houssay, professor of physiology, National University of Buenos Aires; Prof. Frank R. Lillie, professor of zoology and embryology, University of Chicago; Prof. T. H. Morgan, professor of biology, California Institute of Technology, Pasadena; Prof. Paul Sabatier, professor of chemistry, University of Toulouse; Dr. Theobald Smith, formerly director of the Rockefeller Institute for Medical Research, Princeton, New Jersey. *British*, Prof. H. E. Armstrong, emeritus professor of chemistry, Imperial College of Science and Technology, City and Guilds (Engineering) College, London; Prof. J. S. Haldane, director of the Mining Research Laboratory, and honorary professor, University of Birmingham; Prof. Karl Pearson, emeritus Galton professor of eugenics, University of London; Prof. E. B. Poulton, lately Hope professor of zoology, University of Oxford; Sir G. Elliot Smith, professor of anatomy, University College, London; Prof. W. W. Watts, emeritus professor of geology, Imperial College of Science and Technology, London.

Dr. Robert J. D. Graham

THE newly elected professor of botany in the University of St. Andrews, Dr. Robert J. D. Graham, is a native of Perth. He was a student in the University of St. Andrews at University College, Dundee, and at the United College. He graduated at St. Andrews in arts and science and held at the University a Carnegie research scholarship in botany. He spent eleven years in the Indian Agricultural Service, where he did important administrative work as economic botanist to the Government of the Central Provinces in organising botanical study, plant-breeding, etc., in these Provinces. He was granted the degree of D.Sc. by the University of St. Andrews for a thesis on "The Economic and Systematic Botany of the Central Provinces, India". During the War he served in Mesopotamia and was released from military service in 1920 with the rank of Lieutenant-Colonel. When, in the following year, he retired from the Indian Service, he was appointed to a post in the Botany Department of the University of Edinburgh and he has been attached to that Department until now under the late Sir Isaac Bayley Balfour and Sir William Wright Smith. He has had an extensive and varied experience in the teaching of students of botany. A long series of

contributions to botanical science stands to his name in the transactions of botanical societies and journals as well as in the Government publications of India and Mesopotamia. The practical aspect of his work in relation to the propagation of plants and the combating of plant-diseases in India, in Mesopotamia, and in Great Britain has been widely recognised.

The Chinese Mitten Crab

THE Chinese mitten (or woolly-hand) crab, *Eriocheir sinensis* (see NATURE, June 9, p. 855), was transported to Germany from China in some unknown way and was first caught in the Aller (a tributary of the Weser) in 1912, but was not identified until 1923. It has spread widely in the river systems of Germany—the Elbe, Weser, Rhine and Oder. It is stated that about 700,000 of these crabs were caught in 1931 at Hamburg; the crab has in fact become a pest in some places. The adult crabs wander down the rivers at the beginning of the breeding season; pairing takes place in brackish water of the lower Elbe and Weser, but the crabs bearing eggs are found off the river estuaries in more saline water. In the interests of controlling the crab, Dr. W. Wolterstorff, of the Magdeburg Museum, has addressed questions to the Peking Society of Natural History. These and the answers are contained in the *Bulletin* of the Society, vol. 8, Part 3, March 1934. Dr. Wolterstorff refers to a report that the crabs were cleared out of the lower Liang Ho River about twenty years ago with nets, as they destroyed the fish, and asks if this was successful. He directs attention to the statement of Prof. Lu-fong of Tientsin that the Chinese consider the crabs holy and hence the crabs caught are not eaten but burnt, and points out that this is at variance with the statement of Marquard that the crab is a popular item of food in China. In reply to the questions, Y. T. Mao, of the Department of Biology, Yenching University, states that *Eriocheir sinensis* is one of the edible crabs commonly found along the coastal provinces of China and that the Chinese do not consider the crab holy. He adds that according to his observation it is not necessary for the crab to lay its eggs in salt water and that he has not heard that the crabs had to be cleared out from a river at Tientsin, nor has he heard of any river in China inhabited by such a large number of crabs as were stated to occur in the Elbe.

Will the Chinese Mitten Crab Invade British Waters?

THE Ministry of Agriculture and Fisheries has issued a notice (Fisheries Notice, No. 22, June 1934) on this crab, pointing out that it "would in no wise be a welcome addition to the British fauna". During its migrations, particularly upstream, the crab tunnels into river banks and the wash of water in these burrows is liable to cause subsidence and hence serious damage to the banks. Further, the crab is voracious; it clears bait from lines and eats the fish taken thereon, and bites through nets and lines. The note suggests that a careful watch should be kept for this crab, especially on the east coast of Great Britain; its destruction at all possible times might at least assist in restricting the numbers of this unwanted invader.

Science and Social Problems

IN a lecture on "The Man of Science and the Science of Man" delivered at the University of Liverpool on December 7, a copy of which reached us recently, Prof. J. L. Myres discusses the responsibility of science for social disorder. Much of the current confusion of thought in this matter he attributes to the common failure to distinguish discovery from invention, and, more dangerous still, the engineer or inventor from employers or exploiters who require an immediate solution of a particular practical problem in applied science for their own purpose. The man of science has an individual moral responsibility for the full use of his specific powers in investigating Nature and rationalising the world around him, and the growth of personal responsibilities, with the concurrent graver risks of personal abuse, provides some of our most serious social and international problems. One of the problems to which thought has not yet been adequately applied in this way is the problem of leisure, which is one with that of unemployment or disemployment through the growth of rationalisation or mechanisation of industry. For this our system of education, and particularly the high degree of specialisation in the training of students of science, are largely to blame and Prof. Myres enters an eloquent plea for expositors of science who are competent to impart to the general community something of the spirit and methods of science, so as to afford them an adequate general scientific background for the life they lead in this highly technical age.

PROF. MYRES deals also a hard blow at the slovenliness of the scientific worker in his written communications whether for the specialist or a wider public, particularly his neglect to use current linguistic coin, acceptable at its face value of words or sense. These points in a valuable address may easily be overlooked by the scientific worker in his interest in the subsequent discussion of the clash of cultures in modern life and the way in which a science of man could be of service under modern conditions. A field of scientific research is here visualised, the results of which are potentially applicable to a wide range of everyday problems. There is required, too, the capacity to see life as a whole and not as a series of independent units. The latter tendency, no less than excessive specialisation, are major obstacles to the noble conception of citizenship for which Prof. Myres pleads, and which demands the exercise of freedom in speech, in thought and in life.

National Art Gallery and Museum for New Zealand

AT the ceremonial laying of the foundation stone of a National Art Gallery and Dominion Museum for New Zealand, at Wellington, on April 14, Lord Bledisloe, Governor-General of New Zealand, gave

an inspiring address on the proper functions of such an institution. This has just been published in pamphlet form with the title "The Proper Function and Scope of a National Art Gallery and Museum". "A public museum . . . should not be a mausoleum of dead specimens, the resort only of monastic specialists or interested collectors, but a vitalising power-house radiating currents of intellectual energy and calling forth latent genius in all classes of the community". The difficulty is to know how best to do it. Lord Bledisloe suggests many possibilities: popular exhibits, the encouragement of school children, travelling collections to country districts, special exhibits relating to sanitation, hygiene, child-welfare or town-planning, a comprehensive department illustrative of British seafaring life from the earliest times, and so on. He summarises with insight the values of an orderly ethnographic collection—the scientific study of early civilisations, the promotion of a more sympathetic understanding of subject races, the provision of useful equipment to prospective Colonial administrators and pioneers, and the stimulation of trade by suggesting new ideas both to importers and exporters. On the museum side and on the art gallery side he warns curators and administrators over and over again against the danger of accepting gifts too readily, and of accepting gifts with conditions. He sees in the foundation of the new institute a landmark in the definite and vigorous intellectual and spiritual progress of all classes and both races of people in the Dominion.

WHILE in New Zealand Lord Bledisloe was laying emphasis upon the educative aspects of museums, at the Toronto Meeting of the American Association of Museums, on May 31, Prof. John R. Dymond, director of the Royal Ontario Museum of Zoology, sounded a warning note about the danger of too much educational policy (Science Service, Washington, D.C.). Education is one of the important functions of a museum, but it is not the only one, or the primary one. The peculiar work for which museums exist is to collect and preserve the irreplaceable materials needed for the advancement of knowledge. Should too great a proportion of time or energy or income be spent on educational activities, the real work of the museum will suffer. There are other agencies in every State devoted to educational work, but there is nothing to replace the museum if it halts in its labour of making and conserving collections. But the problem is not quite so simple as it looks—there are things that are not worth the labour and expense of collecting and preserving, and who is to draw the line between judicious collecting and aimless, useless amassing? Perhaps the educational aspect is one of the soundest criteria.

The Psychic Thumb Print Controversy

IN Bulletin 22 of the Boston Society for Psychic Research, published in April 1934, is printed the reply to Mr. Thorogood's lengthy report on the alleged psychic thumb prints produced by the American medium 'Margery', which document was issued as vol. 22 of the *Proceedings of the American Society for Psychical Research* and which was reviewed in NATURE of April 14, p. 550. The controversy revolves around the report of the discovery that both the right and left thumb prints of 'Walter' (the medium's control) are in reality identical with those of her dentist now living in Boston. These charges were examined by the officials of the American Society for Psychical Research, who came to the conclusion that they were without foundation, although it was admitted that in the case of one of the thumb prints the resemblance was close. Counter charges of bad faith, falsification of material evidence and sinister motives were made, and it was alleged that certain of the wax prints obtained exhibit clear signs of alteration. In the present *Bulletin* these statements are considered, and further counter charges are made against the officers of the American Society for Psychical Research, including the suggestion that counterfeit waxes have been introduced and dates forged. In a well-balanced review of Mr. Thorogood's book, Dr. Harold Cummins examines the theory that the sets of prints are not identical, but finds himself unable to accept the claim. Moreover, he severely criticises certain photomicrographs printed by Mr. Thorogood inasmuch as in his opinion they are not strictly comparable.

New 24-Cylinder Aero Engine

AN air-cooled 24-cylinder aero engine, the Napier-Dagger, has just completed its 100-hour Air Ministry type test. It has already been flown for more than sixty hours in a Hawker Hart day bomber aeroplane, and took part in this year's R.A.F. display on June 30. The 24 cylinders are arranged in four blocks of six. Two blocks are set above and two below the crank-case, giving the engine the form of a letter H viewed from the front. This arrangement makes for compactness, especially in frontal area, which is about equal to that of a modern water-cooled engine of similar output. Thus the air-cooled engine gains to the extent of the head resistance of the radiators or such devices as are necessary for cooling the liquid in the other. Each pair of upper and lower cylinder blocks has a separate crank-shaft which transmits the power through gearing to the airscrew shaft. The reduction in this gearing allows the very high engine speed of 4,000 revolutions per minute, while the airscrew travels at such lower speeds as its efficiency demands. One of the most interesting features in the engine is the use of hydraulic impulses to operate the valve gear. This removes the need of rocker arms and also gives a quieter engine. The engine is supercharged to develop its maximum power of 705 h.p. at a height of 12,000 ft., and, at a cruising rate of 3,500 revolutions a minute, it yields 630 h.p. These are with standard fuels; much bigger outputs with 'doped' fuel and higher compression ratios are anticipated. A smaller version of this engine has been flying for some time. This has only 16 cylinders arranged in banks of four. It was known originally as the H engine and is now named the Rapier. The bigger engine makes the type fit for use in military aircraft.

State Help for Gliding

REPLYING to a question in the House of Commons on June 27, Sir Philip Sassoon, Under-Secretary of State for Air, stated that the Government has reached the conclusion that some measure of financial assistance to the gliding movement from the Air Votes is justified. This will probably take the form of assistance towards the formation and maintenance of a properly organised central gliding school, which is regarded as essential to the sound development of gliding, coupled with a small capitation grant to approved clubs in respect of each certificate taken out by their members. Details are not yet known, but will be worked out in conjunction with the various interests concerned. The proposal is that a sum of not more than £5,000 annually, for a five-year period in the first instance, shall be granted. Sir Philip expressed the hope that now that official recognition is to be accorded to the national importance of gliding, generous financial support will also be forthcoming from private sources in order to ensure the success of the movement.

Zeppelin *LZ*–129

A NEW Zeppelin airship, *LZ*–129, is now nearing completion in Germany (Science Service, June 6), and if satisfactory will be put into service as a sister ship to the *Graf Zeppelin*, now operating for the sixth season between Europe and Brazil. The east-bound crossing of the new ship is expected to take less than two days, and the return against head winds a little less than three days. The calculated range without refuelling is 8,000 miles. Although only slightly longer than the American *Macon*, at present the largest airship extant, *LZ*–129 will be considerably larger, with a gas capacity of 7,070,000 cubic feet as compared with 6,500,000 of the *Macon*. On her trial flights this summer, she will be inflated with hydrogen gas. It is reported that the use of helium gas is being considered for normal passenger flights. The Diesel engines, totalling 4,400 horse-power, will be in gondolas attached outside the hull, with ladders permitting access to other parts of the ship as in previous Zeppelin designs. German aeronautical engineers have never accepted the recent American procedure of placing the engine compartments inside the 'hull' or skin. The accommodation includes two promenade decks, state-rooms for fifty passengers, running water and baths, and a special smoking room. Besides these appointments are quarters for a crew of 35 and space for a mail and freight load of ten tons.

International Broadcasting Union

THE issue of *World Radio* of June 29 contains an account of the London meeting of the Union Internationale de Radiodiffusion, which was concluded on June 20, and also the report of the Council of the Union. The meeting was attended by seventy-three delegates, including representatives of the broadcasting organisations of twenty European countries, of the two great American chains of stations and of the Cuban broadcasting organisation; and, in addition, delegates from thirteen European State administrations. The general assembly and business meetings were held at the Grosvenor House Hotel, but visits were arranged to such places of interest as the International Trunk Exchange of the G.P.O., to Broadcasting House and to two stations of the B.B.C. The report of the Council of the Union concerns the European wave-length situation, and such subjects as international programmes and their future arrangement, and the legal aspects of authors' rights. The impression of the Council is that, since the introduction of the Lucerne plan, the general situation in regard to broadcasting on the long wave-lengths has been appreciably improved by the partial application of certain recommendations made at Geneva in February. The situation is complicated by the presence in the long-wave band of the stations Luxembourg and Madona, which were not given long wave-lengths by the Lucerne conference. No solution of this difficulty can be found at present, but recommendations were made to the Governments and broadcasting organisations concerned to re-examine the situation arising therefrom with the view of reaching an arrangement satisfactory to all the interested services.

THE report also states that 409 programmes of special interest or high artistic value were offered by members of the Union to their colleague organisations during 1933–34. Certain of these programmes, such as the relays of the bells of Bethlehem and the Byrd Antarctic Expedition, were accepted by members in various continents. The Union has decided to repeat, in some new form yet to be determined, the successful Christmas programme of 1933, wherein several European broadcasters contributed, by means of specially prepared records, seasonable expressions of goodwill from their respective countries. At the sitting of the new Council which terminated the London meetings, Vice-Admiral Sir Charles Carpendale, of the British Broadcasting Corporation, was elected president of the Union for the tenth successive time. The next meetings of the Council of the Union will be held in Switzerland in February 1935, while the next annual general assembly will be in Poland.

Drinking Water and the Drought

DETAILS have been circulated of an emergency organisation which Imperial Chemical Industries, Ltd., Millbank, S.W.1, with the approval of the Ministry of Health, has set up to assist local authorities which may be experiencing difficulties with their supplies of drinking water. In many instances, owing to a shortage of the regular supply, water has to be obtained from other sources, the purity of which may be doubtful and below the usual standard. Such emergency supplies may, however, be rendered quite safe for domestic purposes provided they are first adequately treated and sterilised. Treatment with chlorine in some form is that generally employed, as it is efficient and comparatively simple in application, the four agents generally used being liquid chlorine, 'chloros', chloramine and

ordinary chloride of lime. Imperial Chemical Industries, Ltd., has accordingly posted a staff of experts trained in water sterilisation at its divisional offices in London, Newcastle, Manchester, Oldbury and Bristol, whose services will be at the disposal of any local authority desiring them for advice and assistance, which will be given free. Once the proper dosage of the particular chemical agent selected has been determined, together with the best method of applying the process, the routine application is comparatively simple.

Liverpool and the Atlantic Ferry

A SUMMER meeting of the Institution of Mechanical Engineers in the Liverpool district would not be complete without a paper on ships and their machinery, and during the meeting on June 26–29, Mr. P. Austin, following in the footsteps of the late Mr. A. J. Magennis, contributed a paper on Liverpool and the Atlantic Ferry. Liverpool shipowners have played prominent parts in the long struggle for supremacy on the North Atlantic between such famous lines as the Cunard, White Star, Collins, Inman and others for a century or so. Beginning with the Black Ball line of sailing packets which connected Liverpool and New York in 1816, Mr. Austin traced the development of trans-Atlantic travel down to the present time, mentioning many once famous ships and recalling many great achievements; and in three tables he gave figures of the growth in size, power and speed of typical ships. In concluding his review, Mr. Austin asked, "Is the Liverpool airport to be one of the terminal ports of the Atlantic Ferry of the future?" While not holding that a trans-Atlantic air service is impossible, Mr. Austin has doubts as to its regularity and dependability, due to the vagaries of North Atlantic weather; also there are doubts as to whether such a service ever would be a financial success. As regards the immediate future of the 'Atlantic ferry', the struggle is keener than ever before and the British reply to American, French, German and Italian competition is S.S. *No. 534*.

The National Maritime Museum

IN the House of Commons on June 29, Mr. W. Ormsby-Gore, First Commissioner of Works, moved the second reading of the bill for the setting up of a National Maritime Museum in the buildings recently occupied by the Greenwich Hospital School. The cost of adapting the vacant school buildings is estimated at £29,000 and Sir James Caird has generously offered to defray this sum. Sir James has already given large sums towards the restoration of H.M.SS. *Victory* and *Implacable* and presented the Museum with the Macpherson Collection of Naval Prints. There is nowhere, said Mr. Ormsby-Gore, where one can study the history of our maritime adventure and development, and no attempt has yet been made to illustrate conveniently for the general public the immense field of British maritime endeavour, historical, technical, geographical and commercial, including not only the exploits of the Royal Navy but also of the mercantile marine. A Board of Trustees with the Earl Stanhope as chairman has been appointed and the post of director has been offered to Prof. G. A. R. Callender, of the Royal Naval College, Greenwich, whose enthusiasm and scholarship in all matters appertaining to naval history are well known.

Recent Advances in Physics

THE Manchester and District Local Section of the Institute of Physics holds each year a summer course of lectures, the primary aim of which is to provide physicists in industry with convenient summaries of recent work in various aspects (both pure and applied) of physical research. This year the lectures were held during June in the Physics Department of the University of Manchester. On June 11, Mr. J. D. Bernal (Cambridge) discussed the properties of "Heavy Hydrogen" and indicated some of its possible chemical uses. Prof. E. N. da C. Andrade (University College, London) dealt with the subject of "Viscosity" on June 13. After considering the relation between temperature and viscosity and its representation by a formula, he discussed a theoretical justification for the use of a formula he has developed and finally dealt with some methods of measurement of viscosities. A comprehensive survey of "Units of Matter" was given by Dr. J. M. Nuttall (University of Manchester) on June 25; he discussed the properties of the proton, electron, anti-proton, positive electron, neutron and neutrino, and gave a summary of the experimental evidence supporting the new ideas on atomic structure. On June 27 short communications on "Alloys" were given by Prof. W. L. Bragg, Dr. A. J. Bradley (University of Manchester) and Dr. C. Sykes (Metropolitan-Vickers Electric Co., Ltd.). This is the fourth occasion on which such a course has been held. Last year the meetings were devoted to accounts of the application of physics to particular industries. On this occasion the original plan was adhered to, summaries of recent work in pure science being presented for the convenience of industrial research workers who do not find it easy to follow the many original papers. There has been a gratifying response to the attempt to organise these meetings, and lively discussions have followed most of the papers.

Celtic Earthworks on Salisbury Plain

ARCHÆOLOGISTS are indebted to the Ordnance Survey for further service of no little value in the form of a map of Salisbury Plain, based on the Ordnance Survey map, 1 : 25,000, and showing the Celtic fields and linear earthworks, which is now in course of preparation. The map will be issued in a series of six sections, of which the first, "Old Sarum" (Ordnance Survey, Southampton, 2*s*. 3*d*. net), is now ready. The archæological features of the Ordnance Survey map have been taken as a basis, and to these have been added material from photographs of the plain taken by the Royal Air Force in the course of routine duties and from data recorded by members of the staff of the Survey. Dr. J. F. S. Stone, who has

made a special study of linear earthworks, has also placed his information at the disposal of the Department. No excavations have been undertaken to fill in gaps, but the hope is expressed that archæologists, to whom the map is dedicated, will amplify by their labours the next edition. In a foreword, attention is directed to certain features of the map. A large number of 'barrow circles' have been located by air photography which are here recorded for the first time. Accordingly it has been thought necessary for the sake of consistency to show all barrows from neolithic to Saxon, the long barrows being numbered in accordance with the numbering in the map of Neolithic Wessex. Attention is also directed to the information afforded by the map on the movements of settlement in instances in which the site of cultivation appears to have been stationary and also to that bearing on the purpose of linear earthworks.

Standardisation in Anthropometry

A PRELIMINARY statement, to form a basis of discussion, has been issued by the International Committee for Standardization of the Technique of Physical Anthropology and is published in *Man* of June. This Committee was appointed by the International Federation of Eugenics Organizations at its New York meeting on the understanding that, in the event of an international organisation for anthropology being formed, the Standardization Committee would be free to transfer itself to that body. As this condition has now been fulfilled by the institution of an International Congress of Anthropological and Ethnological Sciences, the question of the future of the Committee will be discussed at the forthcoming meetings of the Federation and the Congress. In the meantime, the document now published by the Committee makes certain suggestions for future action, pointing out that while anthropologists have met on several previous occasions to deplore the lack of system and uniformity in anthropometric measurement, no practical result has followed. It is now suggested that a number of regional committees should be formed, and that each of these should discuss the revision of systems of measurement on both living and skeletal material, which after testing, criticism and revision, might be put forward as regional schemes to form the basis of international discussion. As the urgent need for reform is widely recognised, a determined effort to arrive at agreement should be possible, even though revision is likely to prove a lengthy undertaking.

New Oil Well Drilling Record

A NEW record for deep oil well drilling has been established by the General Petroleum Corporation in the South Belridge Field, San Joaquin Valley, California, by the achievement of a depth of 11,377 ft. (approximately 2·15 miles). This is the first oil well which has been drilled to more than 11,000 ft. and must be considered a remarkable engineering achievement. The well was started in September 1930 and continued until March 1932 when, owing to a 'cut' in the development programme, operations were stopped. Drilling was resumed in August 1933 and the final depth recorded above was reached at the end of May of this year. An equally notable feature of this performance is that a substantial $4\frac{3}{4}$-in. casing string has been landed successfully at the bottom. There have already been shows of oil and gas in this well, but these have to some extent been smothered by the enforced use of large quantities of very heavy mud held at between 104 and 112 lb. per cubic foot to overcome the high gas pressures met with. The *Oil Weekly* of June 11 gives a detailed account of this well and concludes that improved technique and engineering equipment are the outstanding factors which have made this record possible.

Everglades National Park, U.S.A.

AFTER a certain amount of opposition, Bills for the creation of a National Park in the Everglades of Florida have passed Senate and Congress (Science Service, Washington, D.C.). The park to be created will comprise 1,300,000 acres, and will be unique amongst the larger national parks in lacking mountains. The fauna is tropical, comprising snakes and alligators, several beautiful herons, spoon-bills and the almost extinct 'bone-headed' ibis, and characteristic vegetation. Beyond the coast the park will extend to several of the small islands or 'keys', so that a sample of the rich tropical marine fauna will be available to the visitor. Access to the area will apparently be from the present road, the Tamiami Trail, on the northern boundary of the reserve, but further exploration can be made only on foot or in canoes under the guidance of Seminole Indians. Interest is added to the scheme by the proposal to establish a new Seminole reservation to the north of the Tamiami Trail, in close proximity to the Park itself.

Health of the Navy during 1932

IN the "Statistical Report of the Health of the Navy for the Year 1932", recently issued (London: H.M. Stationery Office. 2*s*. 6*d*. net), the Medical Director-General of the Navy, Sir R. St. G. S. Bond, states that in a force of 83,285, the total number of cases of disease and injury was 39,284, equivalent to a ratio of 471·68 per thousand, an increase of 6·12 in comparison with the five years' average, and a decrease of 19·82 in relation to 1931. Only four cases of typhoid fever and eight cases of paratyphoid fever occurred during the year. Fifteen cases of undulant fever were returned, of which twelve were from the Mediterranean Station. Venereal diseases have declined in number, the fresh admissions totalling 4,638 as compared with 4,962 in 1931. Details are given of some of the cases of interest that have occurred, and of research work.

Chimpanzee Twins

DR. ROBERT M. YERKES has described the first authentic recorded case of the appearance of twins in an anthropoid ape family (*Science*, May 11, 1934).

The twins, one male the other female, were born almost a year ago at the Anthropoid Experiment Station of Yale University, at Orange Park, Florida. The parents were chimpanzees, the male about eleven years old and the female about twenty. Although among other primates, such as lemurs, gibbons, baboons and monkeys, twin births, according to Dr. Yerkes, have occasionally been recorded, the higher apes, chimpanzees, orang-outans and gorillas, have not hitherto been known to give birth to more than one young at a time.

Committee on Street Lighting

THE following Departmental Committee has been set up by the Minister of Transport to report on the lighting of streets: Mr. F. C. Cook (deputy chief engineer, Ministry of Transport) (chairman): Mr. J. F. Colquhoun (public lighting engineer, Sheffield); Mr. C. A. Masterman (chief technical officer, Gas Light and Coke Company); Major W. H. Morgan (county engineer, Middlesex); Mr. C. C. Paterson (chairman of the Illumination Research Committee, Department of Scientific and Industrial Research; director of Research Department, General Electric Company); Mr. E. S. Perrin (Ministry of Transport); Major L. Roseveare (borough engineer, Eastbourne); Mr. J. R. Taylor (Ministry of Health); Dr. J. W. T. Walsh (National Physical Laboratory). The secretary of the Committee is Dr. H. F. Gillbe, of the Ministry of Transport, and its terms of reference are: "To examine and report what steps could be taken for securing more efficient and uniform street lighting, with particular reference to the convenience and safety of traffic and with due regard to the requirements of residential and shopping areas, and to make recommendations".

German Association of Men of Science and Physicians

THE German Association of Men of Science and Physicians will hold its ninety-third meeting in Hanover on September 16–20. The invitation to meet in Hanover is now of more than twenty years' standing. It was accepted at the Vienna meeting of 1913 and planned for the next year, 1914. Since then, the Association has held its centenary in Leipzig in 1922, and has travelled south and west and north and east to Innsbruck, Düsseldorf, Hamburg, Königsberg and west again to Wiesbaden and Mainz. Hanover is easily accessible by land and air. This is the first meeting under the new constitution and an impressive proclamation of German science is desired. Public dinners are to be minimised, but exhibitions and excursions are planned. An associate's ticket costs 20 gold marks, application to be made to Geschäftstelle G.D.N.A., Leipzig, C.1, Gustav-Adolfstr. 12. A detailed programme is available showing the general addresses and combined sessions, also the 37 separate sections and some twenty allied associations. The *Zweckverband* provides a brief directory of more than thirty German scientific societies. The exhibition dedicated to "Deutsches Volk—Deutsche Arbeit" is to give a picture of the history of the German race, with emphasis on heredity, genetics and eugenics, and also on chemistry as a domain in which intellectual leadership is fundamental for industry. The local secretaries will be at Hanover, Technische Hochschule, Welfengarten 1. Among the distinguished men who are already announced as likely to be present are Prof. W. Heisenberg, Dr. Eckener and Dr. Sven Hedin.

Announcements

THE fifty-third annual meeting of the Society of Chemical Industry will be held at Cardiff on July 16–20, under the presidency of Dr. J. T. Dunn. The presidential address, entitled "Science and Industry—the Fertility of Ideas", will be delivered on July 17. Other addresses include Prof. H. Freundlich on "Plasticity the Servant of Industry", Sir Harry McGowan (to whom the Messel Memorial Medal will be presented) on "The Uneven Front of Research", and Col. C. H. Bressey on "British Roads Development during the past Fifteen Years".

A RECENT Bulletin (No. 70) published by the Ministry of Agriculture and Fisheries (1*s*.) deals in a thorough way with the keeping and breeding and other activities connected with making the most of "Ducks and Geese".

THE Achema VII Exhibition Guide, a directory of manufacturers of chemical plant and apparatus in Germany, published and issued in connexion with the Achema VII, held at Cologne on May 18–27 (see NATURE, June 2, p. 843) is, we are informed, now available. Copies can be obtained from Dechema, Seelze bei Hannover (1 gold mark, post free).

A VOLUME of "Researches" published from the wards and laboratories of the London Hospital during 1933 has been issued by the Publications Committee, of which Mr. Hugh Cairns is secretary (London: H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1. 7*s*. 6*d*. net). It includes 31 papers dealing with a variety of subjects comprised within the science and art of medicine, and all of them contributing to the advancement of clinical medicine or of medical science.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in pharmaceutics at the Central Technical College, Birmingham—The Chief Education Officer (July 14). An assistant lecturer in zoology at University College, Gower Street, London, W.C.1 (July 18). An assistant keeper (second class) on the higher technical staff of the Industrial Engineering and Manufacturing Department of the Science Museum, South Kensington, London, S.W.7—The Director (July 21). A deputy Government analyst, Ceylon—The Director of Recruitment (Colonial Service), 2, Richmond Terrace, Whitehall, S.W.1 (July 31). A senior lecturer in estate management at the Royal Agricultural College, Cirencester—The Principal. Two demonstrators in the Department of Anatomy, University of Cambridge—The Secretary-General of the Faculties, The Registry, Cambridge.

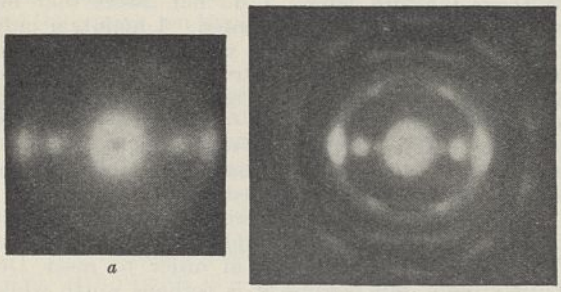
Letters to the Editor

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

Structure of the Wood used in Violins

THE many recent investigations on string instruments[1] deal mainly with two problems: the theory of the mechanical and acoustical behaviour of the different parts of the instrument (and its experimental verification), and the analysis of the tones produced by the instruments. The question of the proper choice of material has made scarcely any progress since the fundamental investigations of F. Savart[2]. Since it has been repeatedly stated that age, treatment and varnish change the character of the wood, we investigated the structure of the wood in violins of different origin* with X-rays. Copper $K\alpha$ (in a few cases also molybdenum $K\alpha$) rays fall (*a*) through the *F*-hole on to the back of the instrument or (*b*) are reflected from the edges of either top or back.

In all of the instruments investigated, we found that the spruce used for the top shows definite fibre structure, giving almost identical patterns (Fig. 1*a*; for comparison see Fig. 1*b*). But the patterns from the wood used for the back (mostly maple) are different for instruments of different tone quality. Instruments with an even and smooth tone quality, especially for higher pitch (*E*-string), show an almost complete lack of orientation in the wood used for the back (Fig. 2). The maple used in instruments which have a harsh tone quality in general, weak response and shrill upper register show marked fibre structure (Fig. 2*b*). Since we found that instruments two hundred years old may show such a pattern, it is clear that the ageing of the wood after cutting and working does not change its structure. Whether a special treatment

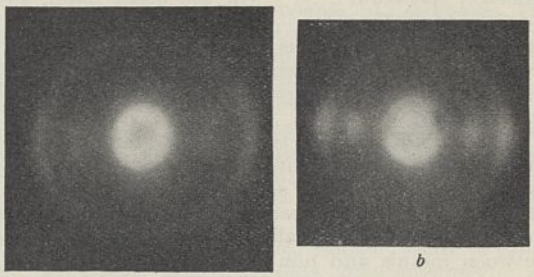


a *b*

FIG. 1. (*a*) Spruce (top) from "Geneva" Guarnerius; (*b*) ordinary spruce.

of the wood or a special varnish has been used by the Italian makers is so far not certain; we found only in one case a diffraction pattern containing one ring which could not be interpreted as belonging to cellulose.

Investigation of untreated maple as used for violin making has shown that sometimes, although rarely, such maple will show as small an amount of orientation as the wood found in good violins. Occasionally modern violins with properly chosen wood for which Italian varnish and treatment of the wood are not used, show an evenness in tone comparable with the old instruments. All this seems to indicate that the proper selection of the wood is more important for the quality of the instrument than treatment and varnish. We found several instruments with the proper wood, but a poor tone quality. This, of course, can be due to the faulty model of the instrument, but in two cases investigated, a radiographic X-ray study of the interior of the violin revealed a great number of



a *b*

FIG. 2. (*a*) Maple (back), J. Guarnerius; (*b*) maple (back) of modern violin.

crude repairs which necessarily would impair the tone of the instrument. We have found that these radiographic studies are of great value in supplementing the knowledge of the connoisseur and collector.

Our investigation indicates that for a fine instrument only the top should be characterised by different velocity of sound in different directions, whereas the velocity of sound in the back should be the same in all directions so as to produce the best results.

K. LARK-HOROVITZ.
W. I. CALDWELL.

Physical Laboratory,
Purdue University,
Lafayette, Indiana, U.S.A.

* We are indebted to Messrs. Lyon and Healey and Wm. Lewis and Son, Chicago, for the possibility of investigating instruments of the following makers: A. and H. Amati, Stradivarius, J. Guarnerius, J. B. Guadagnini, C. Bergonzi, M. Bergonzi, Montagnana, Storioni, Vuillaume, Pique and several modern makers, altogether 24 instruments.

[1] C. V. Raman (summary of all of his important papers); "Handbuch der Physik", vol. 8, pp. 355–424; H. Backhaus, "Handbuch der Experimentalphysik", vol. 17/3, pp. 177–256; 1934. R. B. Abbott, *Phys. Rev.*, August 1933; March 1934.

[2] F. Savart, "Mémoire sur la construction des instruments à cordes et à archet", 1819. The much more important investigations published in *l'Institut*, 8, 55, 69–70, 91, 122, 1840 seem to be entirely forgotten. We found them only quoted in E. Heron-Allen's book on "Violins and Violin Making" and have seen them myself only now. Savart's conclusions should certainly be checked with more modern acoustical methods.

Atomic Theory

MAY I comment briefly on the review of my book in NATURE of June 9, p. 852, by Prof. Fowler, to whom I am grateful for the view that new theories of this nature should always be welcomed. It is to be hoped that serious consideration of the theory will not be prejudiced by what the non-scientific press may have said about it.

(1) *Electrical Conductivity.* It is claimed that it can now be deduced from the *R-B* atom that the alkalis must be metals, and that this can "probably" be extended to the noble metals. This kind of "pious hope", to use Prof. Fowler's own expression, is quite unnecessary with the *A* atom, where the metals, non-metals and sub-metals (for example, boron), automatically fall into their appropriate groups.

(2) *Magnetism.* "It is not, however, yet possible

to say quantitatively that such a metal or alloy will be ferromagnetic and such another one not." This is not surprising, since Prof. Fowler admits that the most the *R-B* atom can do is to suggest that the conditions for ferromagnetism "might" be most easily fulfilled among the metals and alloys of the iron group. This is a long way from explaining, as the *A* atom does in its stride, why ferromagnetism is sometimes *absent* in alloys of the iron group (manganese steel), and sometimes *present* in alloys not of the iron group (Heusler alloys).

(3) *Spectroscopy*. Prof. Fowler must have overlooked p. 39 of my book which begins: "*Under suitable conditions*, every element will yield an emission spectrum . . ." On the other hand, Prof. Fowler himself refers to the oxygen atom as "stubborn". It is this spectroscopic property of oxygen, and of other elements, qualitative, but none the less real and important, which is predicted by the *A* atom.

(4) *Chemistry*. "In the chemical field, the qualitative successes of quantum mechanics and the *R-B* atom seem even more striking." Now, if there is one fact which more than any other is fundamental in chemistry and metallurgy, it is the distinction between metals and non-metals, and since the *R-B* atom cannot make this distinction, except for the alkalis, it is doubtful whether chemists and metallurgists share Prof. Fowler's enthusiasm for the striking successes of the *R-B* atom in this field.

(5) *Alpha Scattering*. "When it [an alpha particle] passes near one of the protonic complexes it will also be scattered by Rutherford's law with a factor P^2 when the charge on the complex is Pe." This criticism, if valid, would effectively dispose of the *A* atom, but it is invalid, because the protonic complexes are not rigidly *fixed* as are the atomic nuclei, but move in quantised orbits, and the recoil conditions are totally different. Since the Rutherford law cannot be applied in the way suggested by Prof. Fowler, he is scarcely justified in basing thereon the claim that: "The alternative atom fails outright, self-strangled at birth."

Nevertheless, in regard to the dimensions of quantised orbits of heavy particles, I admit that the calculations are so difficult that I have not been able to make them, but that does not prove that the *A* theory is wrong, nor can it yet be assumed that the *A* theory is incompatible with Coulombian binding forces, particularly since, as Prof. Fowler admits, it is doubtful whether the scattering experiments are able to test this rather fine distinction.

(6) *Isotopes*. This question does not permit at present either of proof or disproof of the *A* theory, but it does open up certain new lines of research which seem worth pursuing.

(7) *Collision Theory*. Finally, Prof. Fowler reproaches me for not touching on this subject. I remedy this omission, since it throws some light on the question at issue, namely, whether the outer regions of atoms are always negatively charged, as for the *R-B* atoms, or whether, as in the case of the *A* atom, they are positively charged for atoms such as oxygen, and negatively charged for atoms such as argon, or positive *cum* negative for a molecule such as ethylene. Here is something which can at once be tested by mixing these gases under pressure, to see whether there is any tendency towards cohesion. This has already been done by Prof. Irvine Masson, who has observed an abnormal cohesion on mixing oxygen and argon, oxygen and ethylene, and argon and ethylene[1]. This curious phenomenon, which is precisely what one would expect on the *A* theory, has never been explained in terms of the *R-B* theory.

Thus, in spite of the criticism which Prof. Fowler has directed against the new theory, I hope that it will receive further serious consideration and discussion.

JOHN TUTIN.

26, Fenchurch Street,
London, E.C.3.
June 14.

[1] Masson and Dolley, *Roy. Soc. Proc.*, A, **103**, 524; 1923.

I SHOULD have been much disappointed if Dr. Tutin had taken my review of his book 'lying down'. Indeed he has not done so, but he has added little or nothing in his reply to his development of the *A* atom. Paragraphs (1)–(4) merely reiterate what he claims that the *A* atom has done and the *R-B* atom has not. These claims are frankly preposterous.

In my reasoned criticism of Dr. Tutin's book, I took some pains to state at length the present position of the quantum mechanical theory of matter based on the *R-B* atom, and great care to avoid any overstatement of its successes. When it was said that this theory leads to such and such definite results, it was implied that these results were logical consequences of the theory, based on its initial postulates and without any *ad hoc* hypotheses whatever. Chapter and verse can be given for the proofs of all such results. Where I expressed the opinion (a pious hope!) that such and such phenomena were probably explicable in the same way, it was again implied that they were probably thus explicable without additional hypotheses, certainty being merely held up by mathematical complexity, a very different thing from difficulties in or uncertainty of physical principles. In contrast to this, there is not one single statement of a result in the whole of Dr. Tutin's book which can be regarded as there presented as a logical deduction from a definitely stated theory; the scattering laws should perhaps be excepted and to these I return later. I do not assert that his results can never be so presented. I maintain only that none of his results has yet been so presented and that most of them never will be. His candid admission in the last part of section (5) of his reply shows this so clearly that comment is scarcely necessary. It is no use just repeating the claim of what the *A* atom can do, in magnetism, for example. What is required is logical deduction.

I return now to the scattering of α-particles, not because anything need be added to, or withdrawn from, my former criticism, in order to meet Dr. Tutin's reply, but because it is perhaps worth while analysing this reply as a typical example of the vague and unsatisfactory nature of Dr. Tutin's reasoning throughout his book. Briefly, the gist of his objection here is as follows. He has two force centres, *A* and *B*, bound together by certain forces, and a third body *C* collides with them. When *C* goes close to *A*, *A* and *B* are effectively rigidly connected and recoil as a whole. When *C* goes close to *B*, this does *not* happen. Yet the particles are said to obey the laws of quantum mechanics! In any mechanics except the Tutinian, what is sauce for the goose is sauce for the gander, and I cannot withdraw my verdict of self-strangulation, which Dr. Tutin would apparently accept apart from this plea of non-reciprocity.

In the last paragraph of his reply, Dr. Tutin directs attention to some interesting experiments by Prof. Masson on the equilibrium p-v isotherms of binary mixtures of oxygen, ethylene and argon. These experiments on the *equilibrium* states of gas mixtures have little or nothing to do with collision theory as usually understood; this, however, is unimportant. Dr. Tutin claims that the evidence they supply for a fairly strong attraction between pairs of molecules of these gases is in favour of his theory and against the *R-B* atom, because with the *R-B* atom all these molecules will be negatively charged on the periphery. He overlooks entirely the fact that for electrically neutral systems (such as these molecules) the residual polarisation effects with which we are here concerned always yield an extra attraction no matter what the unperturbed arrangement of their charges. This is a classical result which prevents discrimination between such theories in any such way.

Here, for the present at any rate, one may well take leave of Dr. Tutin's theory. *If* it ultimately proves of value and supersedes the *R-B* atom, no one will be more surprised than the present reviewer —and no one more delighted. Such success would imply the construction of a logical theory appreciably more successful than current theory in interpreting the properties of matter, and current theory is a lusty infant of whom its parents and guardians, even metallurgical and chemical, are justifiably proud.

R. H. FOWLER.

Spontaneous Emission of Neutrons by Artificially Produced Radioactive Bodies

I. CURIE, F. Joliot and P. Preiswerk[1] observed that after bombarding silicon or phosphorus by neutrons, the artificially produced radioactive nuclei emitted: (1) negative electrons as previously observed by Fermi[2]; (2) γ-rays of high energy ($\sim 5 \times 10^6$ e.v.); (3) positrons (which they tentatively suggest to be due to the creation of 'pairs' by the γ-rays, an explanation which does not seem very probable as they state that the positrons have an upper energy limit of $\sim 1 \times 10^6$ e.v. only); and (4) *neutrons*. They assume that some of the radioactive nuclei are $_{13}Al^{28}$ and $_{14}Si^{31}$, and that the spontaneously emitted neutrons are due to the transformation processes:

$$_{13}Al^{28} \rightarrow {}_{13}Al^{27} + {}_{0}n^{1} \text{ and } {}_{14}Si^{31} \rightarrow {}_{14}Si^{30} + {}_{0}n^{1}.$$

If this formal explanation is correct, the neutron must have existed in its parent nucleus in a state of *positive* energy. But this would mean that there exists in a nucleus a potential barrier for neutrons, which would not only contradict current theoretical views about the interaction forces between neutrons and neutrons or protons[3] but would also be in disagreement with Fermi's[2,4] discovery that neutrons easily penetrate into nuclei of all charges and masses.

The spontaneously emitted neutrons must therefore get into a state of positive energy by some primary radioactive process, and then be *immediately* emitted. Assuming the potential energy of a neutron in the field of any nucleus to be everywhere negative, and the potential energy of a proton to show a 'barrier', we have two possibilities for explaining the emission of neutrons:

(i) In the radioactive nucleus A, all negative energy states of protons are occupied and there exists *one* proton in a state of positive energy. This proton may either penetrate the barrier of A or transform into a neutron, emitting a positive electron. We must assume that the neutron can be created in a state of positive energy. It can then *either* be emitted *or* fall into a state of negative energy, causing an emission of a γ-ray. But it is rather unlikely that an unstable nucleus produced out of a stable nucleus by neutron bombardment (and therefore short of protons) should not have an unoccupied negative energy state for a proton. If A has an unoccupied negative energy state, a proton cannot remain an appreciable time in a state of positive energy.

(ii) The radioactive nucleus A contains two loosely bound neutrons. One of the neutrons (n_1) transforms into a proton, emitting a negative electron. The proton may be created in an excited state p' and then fall down to a lower state p, whereby it can emit a γ-ray. Alternatively, the transition energy can be handed over to the second neutron (n_2) which will thus be raised to a state of positive energy and will then be emitted. This model seems preferable to (i).

Recent observations of M. Mäder[5] seem to show that samarium emits protons spontaneously. As samarium is known to emit α-rays[6], it may be that the emission of a proton (or alternatively the emission of a γ-ray) follows immediately after the emission of an α-ray. If this is not the case, we must conclude that one isotope of samarium contains a proton in a positive energy state. From (i) we might then expect samarium also to emit positrons, for a nucleus with a proton in a positive energy state certainly has a lower unoccupied state for a neutron, which makes a proton → neutron transition energetically possible. The neutrons can then only be emitted if they are created in states of positive energy.

M. GOLDHABER.

Magdalene College,
Cambridge.
June 22.

[1] *C.R.*, **198**, 2089, June 11, 1934.
[2] *Ricerca Scientifica*, V, **1**, 283, 330; 1934. NATURE, **133**, 757, May 19, 1934.
[3] W. Heisenberg, *Z. Phys.*, **77**, 1; 1932. **78**, 156. **80**, 587; 1933. E. Majorana, *Z. Phys.*, **82**, 137; 1933.
[4] NATURE, **133**, 898, June 16, 1934. E. Amaldi, O. D'Agostino, E. Fermi, F. Rasetti, E. Segre, *Ricerca Scientifica*, V, **1**, 452; 1934.
[5] *Z. Phys.*, **88**, 601; 1934.
[6] G. Hevesy and M. Pahl, NATURE, **130**, 846, Dec. 3, 1932.

Hyperfine Structure of the Resonance Lines of Potassium

THE hyperfine structure of the resonance lines (7699 and 7665 A.) of potassium has been investigated by means of absorption in a potassium atomic ray. The lines were obtained in emission from a discharge tube containing neon at a pressure of a few millimetres, and potassium vapour at a pressure of less than one two thousandth of a millimetre; the tube was excited by means of external electrodes, and was of the type used by Jackson in previous investigations on the structures of resonance lines.

Before entering the spectrograph, the resonance light passed through a ray of potassium atoms, the direction of the atomic ray being at right angles to the line of sight. The atoms forming the ray passed through a cool tube the length of which was twenty times greater than the width, so that the component

of the velocity of the atoms in the direction of the line of sight was reduced to one twentieth of the normal atomic velocity. The Doppler width of the absorption lines produced by the atomic ray is therefore only one twentieth of that given by potassium vapour at the same temperature with random distribution of velocities; this is equivalent to absorption by potassium vapour at one four-hundredth of the temperature, that is between 1° and 2° Abs. The spectrograph used for examining the atomic ray absorption contained as high resolving power instrument a Fabry-Perot étalon (this instrument is particularly effective in the infra-red on account of the high reflecting power of silver) with a plate separation of 10 cm., and a resolving power of about six million. In the absorption, each of the resonance lines was found to consist of two very close components; the separation of these components was approximately 0·015 cm.$^{-1}$.

The observed doublet hyperfine structure corresponds to a splitting of the 4 $S_{1/2}$ term of the lighter isotope, 39, of potassium (the heavier isotope is present to the extent of about 5 per cent, which is insufficient to give rise to absorption under the experimental conditions). This indicates a value of the nuclear magnetic moment between 0·3/1838 and 0·5/1838 of a Bohr magneton, according to the quantum number of the nuclear spin (I).

The resonance lines of sodium were also examined by absorption in an atomic ray, an étalon of 4 cm. plate separation being used. Both the lines were found to be close doublets, the separation of the two components being 0·06 cm.$^{-1}$. This is in agreement with the structure of the sodium lines found by Schueler, working with a liquid air cooled, hollow cathode discharge tube.

D. A. JACKSON.
H. KUHN.

Clarendon Laboratory,
Oxford.
June 21.

Negative Nuclear Spins and a Proposed Negative Proton

THE atomic nuclear spin data obtained from the analysis of fine structures in line spectra show that odd atomic weight atoms have nuclear spins. There are two groups of odd atomic weight atoms, namely, those with odd and those with even atomic charges. The nuclei of the first group contain an odd number of protons and the nuclei of the second group an odd number of neutrons. A significant experimental fact is that all the nuclei in the first group have positive nuclear spins, whilst nuclei of the second group can exhibit either positive or negative spin values.

Landé[1] has proposed a theory to account for the nuclear spin properties of the first group by assuming that only the single odd remaining proton, which has both spin and orbital momenta, produces the nuclear spin properties. This theory gives approximately correct values for many nuclear magnetic moments. If the theory is extended to the second group of odd atomic weight nuclei, a difficulty arises because of the negative spins. Schüler[2] has suggested that the remaining nuclear core also has spin properties, and by introducing a new quantum number infers that the neutron has a negative magnetic moment. There are, however, difficulties in the theory.

It seems possible to account for the negative and positive spins of the members of the second group mentioned above by postulating the existence of two types of nuclear neutrons, namely: (*a*) *proton* plus *electron*, (*b*) *negative proton* plus *positron*. Atoms which have a remaining odd neutron of type (*a*) will exhibit positive nuclear spin, and those with a remaining odd neutron of type (*b*) will exhibit negative spin. On this view the numerical values of the positive and negative $g(I)$ factors should be similar, which is indeed found to be the case.

It is assumed that the negative protons only exist in the bound state of neutrons when they are in the nucleus. Since the difference between the two types of neutrons lies in the relative orientations of the mechanical and magnetic moments, it is not likely that disruption experiments will distinguish between them. The confirmation of the existence of the positron suggests, on grounds of symmetry, that a negative proton might be expected to exist*.

S. TOLANSKY.

Astrophysics Department,
Imperial College of Science,
London, S.W.7.
June 7.

* *Note added in proof.*—After my letter was communicated to NATURE, a note by Schüler and Schmidt (*Naturwiss.*, **22**, 418; 1934) was received wherein the existence of two types of neutrons is also suggested. Tamm and Altschuler (*C.R. Acad. Sci. U.R.S.S.*, **1**, 455; 1934) have attempted to explain the difficulty of negative spins by assuming that several neutrons can contribute to the spin properties.

[1] Landé, *Phys. Rev.*, **44**, 1028; 1933.
[2] Schüler, *Z. Phys.*, **88**, 323; 1934.

The Changing British Fish Fauna

INTRODUCTIONS of foreign species, the results of which deserve close scrutiny, are not confined to mammals. Rainbow trout are now a permanent element in our fauna, black bass are established in certain places, and now the case of the pike-perch in East Anglia deserves to be put on record. On March 4, 1934, a *Lucioperca* of 11¾ lb. was caught in the River Delph, near Welney, in the Ouse basin, and was brought here for identification. Five species of the genus are known, two in the rivers and lakes of eastern and northern Europe, one in the Black and Caspian Seas, and two (placed by some authors in a separate genus *Stizostedion*) in Canada and the northern U.S.A. Comparison with specimens in the B.M. (Nat. Hist.) revealed that the Welney fish resembles the American species in five characters and the European in four, but in view of the structural importance of the American characters (especially the distance between the pelvic fins) it is reasonably certain that it came from the American species *Lucioperca vitrea*, Mitchill.

It seems that only one successful introduction of pike-perch to Great Britain has been made, and that was the European *L. lucioperca*, of which 24 fish were put in a pond on the Duke of Bedford's estate at Woburn in 1878. The only explanation of how an American species came to be in England, however, is that it was introduced in mistake for black bass. Inquiries have shown that some nine years ago 20 fingerlings hatched from American eggs which were supposed to be black bass, were put into the Ouse at Erith Bridge, and Prof. Gardiner concludes from scale examination that the Welney fish was in its tenth winter, which suggests that it was one of these 'black bass'. Now a pike-perch can easily be mistaken for a gaunt black bass, so it is

quite possible that American pike-perch are living in other waters to which black bass have been introduced. The danger to our indigenous fauna which the presence of such a predator entails need scarcely be mentioned, but the fact that it seems to have changed structurally in the new environment may throw some light on fish evolution if a British race of *L. vitrea* becomes established.

E. B. WORTHINGTON.

Zoological Laboratory,
Cambridge.

Effect of Yeast Extract on the Growth of Plants

THE communications on the above subject in the columns of NATURE by Prof. Artturi I. Virtanen[1,2] and Synnove V. Hausen of the Biochemical Institute, Helsingfors, and by Prof. V. Subrahmanyan and G. S. Siddappa[3] of the Indian Institute of Science, Bangalore, are intensely interesting in that they confirm our earlier work on the effect of live and autoclaved yeast and yeast extracts on the growth of plants.

The authors are apparently unaware of our work and so we wish to invite attention to it and to state that it was published in the year 1927[4] as a Memoir of the Imperial Department of Agriculture in India, under the title "The Effect of Manuring on the Vegetative and Reproductive Capacity of the Seed". In this contribution, which deals with the effect of mineral fertilisers and organic manures on the quality of grain as seed and as food, there is a section devoted to the rôle of organic matter in plant nutrition. Here, several experiments on the effect of yeast on different crop plants in sand cultures, soil in pot cultures, and in small plots were reported.

The crops studied were *Eleusine coracana*, *Pennisetum typhoideum*, *Panicum miliaceum*, *Andropogon Sorghum*, *Lycopersicum esculentum* and *Triticum vulgare*. In every case, minute quantities of yeast, either alive or autoclaved, contributed remarkably to growth, flowering and reproduction. It has also been shown that indications were obtained that yeasted grain possessed better nutritive value than unyeasted grain when fed to albino rats. Evidence was given and arguments were advanced to show the possibility of absorption of the growth-promoting factors of the yeast by the plants through their roots, and of the conveyance of these to animals. We also pointed out in the same publication that in the presence of a good supply of organic matter or on soils rich with silt brought down by rivers flowing through forest areas, this effect might not be so marked or might entirely disappear.

One of us (B. V. N.) in recent publications[5,6] discussing the work in progress in our laboratories, directed attention to the hitherto unsuspected rôle of micro-organisms in plant nutrition to which Prof. Virtanen refers in his second letter.

B. VISWA NATH.
M. SURYANARAYANA.

Chemical Laboratories,
Agricultural Research Institute,
Lawley Road P.O., Coimbatore,
India.
May 26.

[1] NATURE, **132**, 408, Sept. 9, 1933.
[2] NATURE, **133**, 383, March 10, 1934.
[3] NATURE, **132**, 713, Nov. 4, 1933.
[4] *Mem. Dept. Agri.*, India, Chemical Series, **9**, No. 4; 1927.
[5] "Some Aspects of Plant Nutrition", *Soc. Biol. Chemists*, India; 1932.
[6] *Soc. Biol. Chem.*, India, Symposium, July 1932, p. 12.

Science and Intellectual Liberty

As a German professor, living abroad and without any official connexion with the National-Socialist Government or Party, I would appreciate the publication of some remarks on the attitude of the German Government towards science. On this topic an article was published in NATURE of May 12 under the title "Science and Intellectual Liberty" and a letter by Prof. J. B. S. Haldane appeared in the same issue. Other articles and letters have been published in NATURE, in one of which (June 17, 1933) it was said that "intellectual companionship" with Germany has been made "difficult".

In NATURE of May 12, 1934, I found the phrase "the revocation of academic freedom in Germany will no more be forgotten than the revocation of the Edict of Nantes". Prof. J. B. S. Haldane cites a sentence from one of the prominent National-Socialists acting as rector of the University of Frankfort; this sentence he designates as "not an isolated example of the attack on objectivity, on, in plain English, truth, which appears to be taking place in modern Germany".

I am sure that every reader of NATURE will realise the very grave situation indicated by these few quotations. For centuries, men of science in Great Britain and in Germany have collaborated, both of them in the first rank of the human fight for truth and progress. Now one of these two groups of scientific men seems to be in danger of losing its credit in the eyes of the other through permitting the suppression of objective truth by the present leaders of its own universities.

The rector of the University of Frankfort said that the task of the German universities *to-day* is not to cultivate objective science, but to form the will and character of their students, This is considered by Prof. Haldane as one of the German attacks on objectivity and truth. This and the elimination of a considerable part of the staff of German universities seems to indicate that academic freedom in Germany actually is partly suspended and regarded as less important than national education of the future leaders of the people.

Knowing personally many British men of science, and having been a guest of some of your universities and institutions, I realise that it may be exceedingly difficult to understand in Great Britain the present situation of science in my country.

It would be easier to understand the present events in German universities if readers of NATURE for a moment could imagine a situation in the British Empire comparable to the situation of Germany since the War.

A great people like the British or German nation cannot live without full independence or sovereignty, that is, freedom from foreign interference. If you are able to realise—I repeat, only for a moment—a situation of lost independence of your country, you will also realise the necessity of concentrating every mental force, especially of the cultivated classes, on the one most important vital task, namely, to regain the national independence, to obtain deliverance from the humiliating conditions of enforced treaties.

I am sure that no one in England would complain in a national disaster like ours, if every institution of the country had to postpone everything, including scientific research (objective science), in order to strengthen the mental forces of the people, especially of its future leaders.

I have the impression, and I suppose everybody has, that Germany, since the beginning of its new regime, has made some steps nearer to independence, nearer in any event than Herr Stresemann's Germany ever was. I am sure that my country will reinstate the full academic freedom of its universities and science, as soon as political sovereignty in our own country is assured.

R. WOLTERECK.

College of Agriculture,
Ankara.
May 25.

IT may well be that Prof. Woltereck's restrained and courteous letter will produce upon his colleagues in Great Britain a more painful sense of alienation than the disturbing utterances of those who now control German academic life. We English do not need to be reminded that political excitement often betrays wise and good men into strange company. We are the last people in the world to deny that, in times of panic or excitement, we have said and done things which in retrospect are recognised by us to be wrong and humiliating. But what seems to men of science most deplorable is the elevation of national passion into a principle, the acceptance of a policy which teaches that to attempt to find and hold truth is but a secondary and subordinate activity of the human mind to be postponed or slighted for *any* reason whatever.—Editor of NATURE.

Inheritance of Habits

DR. S. MAULIK[1] has well pointed out the necessity for distinguishing between experiments, like maze threading, in which the nervous system of the animal is primarily concerned, and other experiments in which a foreign substance or a new food material is introduced into the organism—when we attempt to decide whether the new experiences "produce any physical change in the organism".

In regard to the second group, some information can be obtained from a study of the immunity reaction. In the report of the Medical Research Council "On the Chemistry of the Antigens and Antibodies"[2], Dr. L. R. Marrack describes certain experiments by Landsteiner and others, in which an artificially prepared substance—atoxyl azo protein—when injected into the blood, confers on the serum of the animal so treated a capacity to precipitate any other protein, if it is coupled with the diazotised atoxyl.

A physical change is thus brought about in the organism by the introduction of an artificially prepared protein antigen, of which neither the animal nor its ancestors can have had any previous experience.

It is also significant that the organism modifies the molecular composition of the foreign antigen before assimilating it, somewhat as it breaks up, and resynthesises, ordinary food material, though after the incorporation of the foreign protein the constitution of the organism itself also becomes altered.

The immunity so acquired is, however, not transmitted to offspring, at any rate in the human subject, because experience shows that acquired immunity against subsequent attack by the same disease organisms, for example, measles, is not hereditarily transmitted in man.

Prof. MacBride's feeding experiments were carried out on the Ceylon stick insect[3].

It is possible, as I have elsewhere[4] suggested, that human germ cells may be more isolated, that is, more fully protected against influences from the internal environment, than the germ cells of insects, or some other animals. Hence it is not wise to argue directly from one case to the other without further experimental evidence.

C. J. BOND.

Fernshaw,
Springfield Road,
Leicester.
May 30.

[1] NATURE, **133**, 760, May 19, 1934.
[2] M.R.C. Special Report Series 194, Chap. iii.
[3] NATURE, **133**, 598, April 21, 1934.
[4] Withering Lecture II, University of Birmingham, 1932, "On the Making of Use Acquirements, etc."

PROF. MACBRIDE[1] and Mr. Maulik[2] have raised in the columns of NATURE the important question of the inheritance of acquired habits. Mr. Maulik, if I understand him correctly, states that the offspring of mice trained to run through a maze acquire the same habit more easily than their parents. A reference to the journal in which this remarkable result is published was not given. Mr. Maulik regards it as necessary, before conclusions are drawn, to obtain information as to the nature of the physical change produced by habit in the organism and its reproductive cells. While such information is desirable, it is surely a biological fact that some habits are inherited, even if we do not know the nature of the process of their inheritance. Thus the statistical laws of inheritance of human stature are known, though we have no idea, for example, how many genes are concerned in the process.

Such an excessive demand can only obscure the important issues raised by Miss Sladden's[3] demonstration of the transference of an induced habit (namely, that of feeding on ivy) from parent to offspring in *Carausius morosus*. At least three possibilities suggest themselves. The young insects on hatching may be so saturated with bitter substances from the ivy eaten by their mothers that ivy is less repugnant to them than to insects not so saturated. They may be affected by a *Dauermodifikation* inherited from the mother only and disappearing in a few generations, such as those described by Jollos. Or they may have acquired a character transmissible by both parents, as are most interspecific differences, or such inter-varietal habit differences as that between broodiness and non-broodiness in poultry, or wildness and tameness in mice.

Only in the latter case would the transference of an acquired habit have the relevance for the problem of species formation which Prof. MacBride claims for it. Nevertheless, it should be perfectly possible in suitable cases to test such claims without the very complete knowledge which Mr. Maulik demands.

J. B. S. HALDANE.

John Innes Horticultural Institution,
Merton, S.W.19.
June 8.

[1] NATURE, **133**, 598, April 21, 1934.
[2] NATURE, **133**, 760, May 19, 1934.
[3] *Proc. Roy. Soc.*, B, **114**, 441; 1934.

Collecting Spilled Mercury

ON four occasions lately in the presence of a number of skilled experimentalists I have asked the question—How would you pick up from a floor, with a smooth cork carpet covering, a quantity of mercury which had been dropped and broken up into innumerable globules? I added on each occasion that I thought it likely that any laboratory boy would know but that no professor would. Not once have I received an adequate answer. I have only asked one laboratory attendant, but he was no wiser than his professor. I specify the nature of the floor covering because a Turkey carpet or floor boards with intervening spaces and nail holes are not suitable. The smooth cork carpet is the best floor covering for laboratories other than metallurgical and for lecture tables, and is in common use for these purposes. The question, therefore, touches most of us. Well, the answer is, sprinkle lightly the area which the globules have reached with drops of water from a wash bottle. Then with a squeegee or the straight edge of a piece of strawboard sweep the wetted globules of mercury together. If dry the process is hopeless, they continue to run away and are essentially elusive, but once wet they are tamed, they have the brake on and will not run, and however small they may be they seem to love one another and all cling together in a mass. Then with the same tool or a smaller one sweep them into a small dust-pan made of thin celluloid or even card. The floor is then cleared of all the mercury. Do it.

C. V. BOYS.

Increase of the Percentage of Diplogen in Water during very slow Evaporation

IT is known that one of the methods of separating heavy water consists in the fractional distillation of ordinary water. I find that relatively strong enrichment of diplogen occurs during the slow evaporation of water. About three years ago a bottle containing 25 litres of distilled water was prepared for an experiment. The bottle was not used, and the water slowly evaporated leaving about 600 c.c. residue. The measurements showed that this water had a density of 1·0016 (4° C.). For comparison, I have evaporated by boiling a certain quantity of water to 1/60 of its initial volume. The residue had, however, a density of 1·0001. It is evident, therefore, that the action of slow evaporation is more efficacious than the action of boiling.

Extrapolating the equation given by Luten[1] for smaller ratios of D_2O/H_2O, it is possible to calculate that the density, 1·0016, corresponds to a concentration of 1·65 per cent of D_2O.

These observations suggest where to search on the earth for sources of water of greater density. Up to the present, practically no difference has been found in the density between samples of water taken from different points on the earth[2]. I think it probable that heavy water will be found in mountain caves rather than in the large surfaces of seas, where the evaporation is very intense.

T. TUCHOLSKI.

Department of Medicine,
University, Poznań.

[1] D. B. Luten, *J. Phys. Rev.*, **45**, 162; 1934.
[2] H. A. McKay, NATURE, **133**, 611, April 21, 1934. E. W. Washburn, E. R. Smith, *Science Abstracts* (S.A.), **37**, 434; 1934. E. S. Grifilan, Jr., *J. Amer. Chem. Soc.*, **56**, 406; 1934.

Chromosome Numbers in Menispermaceæ

IN a recent communication to NATURE[1], entitled, "Origin of the Angiosperms", Dr. Anderson puts forward the interesting suggestion of the possible origin of modern flowering plants through the Magnoliales from wide crosses between different groups of Gymnosperms showing 12 and 7 as the base number of their chromosomes, such as the modern Ginkgoales, Cycadales and Coniferales show on one hand, and the Gnetales on the other. The various genera of the Magnoliales show 19 as the base number of their chromosomes, which is rather unusual among other families of flowering plants. We have in this laboratory been working for a considerable time on the cytology of the family Menispermaceæ (results not yet published), a close ally of the Magnoliaceæ, and have found the haploid number of chromosomes in *Tinospora cordifolia*, Miers, to be 12, and in *Cocculus villosus*, DC., 19 (12 + 7). Dr. Lindsay[2], in *Menispermum canadense*, Linn., has found the haploid number of chromosomes to be 26 = 19 + 7 = 12 + 7 + 7. It may be asked whether there is any significance in these chromosome numbers in relation to Dr. Anderson's hypothesis. The difference of seven chromosomes between each of the three plants and 12 chromosomes in the species with the lowest number are certainly suggestive facts.

A. C. JOSHI.

Benares Hindu University,
India, May 24.

[1] Anderson, E., NATURE, **133**, 462, March 24, 1934.
[2] Lindsay, R. H., "The Chromosomes of some Dicœcious Angiosperms", *Amer. J. Bot.*, **17**, 152; 1930.

The "Johannes Schmidt" Ridge in the Indian Ocean

IN his second report on "The John Murray Expedition to the Arabian Sea" (NATURE, May 5, p. 669), Lieut.-Col. Seymour Sewell announces that the echo soundings made from H.E.M.S. *Mabahiss* prove the existence of a vast submarine ridge running diagonally across the north Indian Ocean from the south-east to the north-west and connecting the Chagos Archipelago with Socotra and the Gulf of Aden. May I suggest that the name of Denmark's great oceanographer, the late Dr. Johannes Schmidt, whose discovery of this submarine formation Col. Sewell graciously acknowledges, shall be given to it?

HANS PETTERSSON.

Göteborgs Högskola.
May 22.

Density of Dead Sea Water

SIR ROBERT ROBERTSON has recorded in NATURE the results of some determinations of the density of water from the Dead Sea[1]. We had also determined independently the density of two samples from different places by (*a*) the use of a 25 c.c. pyknometer, and (*b*) a differential method employing two sinkers of nearly the same dimensions. The uncertainty in either method is about one in 10^5. In none of the six determinations made could we detect any significant difference between water from the Dead Sea and redistilled water from the laboratory.

R. J. CLARK.
F. L. WARREN.

Egyptian University,
Cairo, June 5.

[1] NATURE, **133**, 611, April 21, 1934.

Research Items

Palæolithic Affinities in Palestine. Miss Dorothy Garrod publishes in *Antiquity* for June a survey of the results obtained by her cave explorations on Mt. Carmel in Palestine, bringing them into relation with discoveries of palæolithic age in other parts of Palestine, and offering tentative suggestions for a correlation of Palestinian palæolithic with that found elsewhere. As only certain points are noted here, it must suffice to say that the Carmel cave series covers from Natufian (Mesolithic) to Tayacian, the recently recognised rough flake industry, dated as to its phase II here represented at the beginning of the Riss-Würm interglacial. For details of the sequence and their distribution in the caves, reference must be made to the original paper. The outstanding feature of the Lower Natufian is the artistic skill of the people shown in bone and stone carving. M. Neuville also has found recently a fine specimen in a cave near Bethlehem. Four stages of the Aurignacian were found, of which the Upper is not comparable with European Aurignacian, but probably with Magdalenian. The next Aurignacian phase (Wad layer *D*) resembles closely, not African, as might be expected, but European Middle Aurignacian, hitherto thought to be a local development from Lower Aurignacian, as Europe was then close to Africa. The earliest Aurignacian (Wad layer *F*) includes a small group of leaf-shaped points which are not known in Europe, but afford a definite link with Africa, where they occur in the Aterian found by Miss Caton-Thompson at the base of the Upper Palæolithic at Kharga. The Aurignacian fauna indicates a change from wooded to open country, whereas the fauna of the Lower Mousterian (Tabun *C*) points to warm swampy conditions with heavy rainfall (rhinoceros, hippopotamus, crocodile). Here was found the nearly complete Neanderthal skeleton, dating from the later Riss-Würm. For the earlier palæolithic stages not represented in the caves, evidence is afforded by Sir Flinders Petrie's recent Acheulean finds at Gaza, in finds by Neuville, south of Bethlehem, and the Chellean and Acheulean tools found by Breuil and Neuville in Jerusalem. Roughly, Tayacian and Acheulean coincide in date with Europe in the Riss-Würm, and climatic conditions suggest correlations with pluvial conditions in East Africa.

Tribal Migrations East of the Mississippi. Mr. David I. Bushnell, Jr., has prepared a series of maps (*Smithsonian Misc. Collect.*, 89, No. 12) to show the country traversed or occupied by the tribes east of the Mississippi before they first became known to Europeans, when their distribution was that shown in J. W. Powell's linguistic map, as corrected by more recent research. Mr. Bushnell's evidence is derived from the investigation of ancient sites, as well as a comparison of language, customs, etc. The earliest movements were probably Uchean and Siouan, and the ancestors of the Natchez, Timucua and Calusa may belong to the same early period. These last two are the proto-Muskhogean. The Siouan advanced into the valley of the Ohio and may have been responsible for the erection of the great earthworks, while the massive mounds of Cahokia and others as far as Georgia may have been erected by proto-Muskhogean. The Iroquoian and Muskhogean, with the Caddoan to the west of them, were still on the right bank of the river. In the next period the proto-Muskhogean reached Florida, the States of Tennessee and Kentucky were crossed and recrossed by Siouan, Uchean, Iroquoian and Muskhogean stocks; while Algonquian, possibly now and certainly later, frequented the same region. In the third period, fortified camp and village sites have been traced northward from central Tennessee and Kentucky across the Ohio in the eastern counties of Indiana to the north of the State and thence eastward to the traditional home of the Iroquois. These sites were constructed and occupied by Iroquoian tribes. This northern thrust separated peoples of the Algonquian and Siouan groups, who had been in contact in southern Ohio. The groups of tribes continued to move until by the sixteenth century they were located as indicated on Mr. Bushnell's last map, with the Siouan scattered far from their homes in Ohio and the Muskhogean occupying the greater part of the south-east.

Some New Deep Sea Fishes. Mr. Albert Eide Parr in his paper "Deep Sea Berycomorphi and Percomorphi from the Waters around the Bahama and Bermuda Islands. Scientific Results of the Third Oceanographic Expedition of the *Pawnee* 1927" (*Bull. Bingham Ocean. Coll.*, 3, Dec. 1933) presents a sixth report dealing with the deep sea fishes collected during the *Pawnee* expedition under the sponsorship and direction of Harry Payne Bingham. Two new families, six new genera and eleven new species are introduced. Several hitherto little-known species are also described. The new families Gibberichthyidæ and Korsogasteridæ (both in the Berycomorphi) each include a new genus of one species, *Gibberichthys pumilus* and *Korsogaster nanus*: the first seems to occupy a peculiarly isolated position and the introduction of a new family is apparently fully warranted. Unfortunately, only one specimen was available, as is also the case with *Korsogaster nanus*, which shows a fairly close resemblance to *Leiogaster*, differing in the absence of scales and the development of dermal spines in their place, and in several other features. A female specimen of *Parabrotula dentiens*, Zugmayer, gave birth to living young immediately after capture. One of these young, 6·5 mm. long (the mother being 41 mm. long, without caudal fin), is illustrated, showing a somewhat tadpole-shaped body with attachment cords still remaining, a simple continuous fin round the tail and very small pectorals.

Phases of the Red-winged Locust. In the *Bulletin of Entomological Research* of March 1934 (25, Pt. I), Messrs. A. P. G. Michelmore and W. Allan contribute a paper on this subject. The prevalence of a cycle of activity of the red-winged locust (*Nomadacris septemfasciata*) in north-eastern Rhodesia began with the appearance of swarms in an area of marsh country. This event gave opportunity for studying the *gregaria* and *transiens* phases of that insect, but no undoubted examples of the phase *solitaria* were met with. Cage experiments, made with crowded hoppers, suggest that activity is the factor in crowding which influences the production of *gregaria* characters, as maintained by Faure. The prevalent green colouring of *transiens* (*dissocians*) hoppers appears to be associated with high humidity and the

presence of green food. Other colour types of the *transiens* phase are conditioned by those of the environment. An aberrant pallid type of hopper is described and its origin appears to be due to the effects of parasitism by nematodes and possibly also by dipterous larvæ. Factors influencing adult coloration are discussed. Adults crowded in cages, and derived from hoppers reared similarly under crowded conditions, did not undergo the same colour changes observed in the field. The red swarming coloration failed to develop in caged individuals and was replaced by a brown pigment which assumed a similar distribution over the insect. Biometrical data obtained from a variety of types are tabulated and discussed. It is shown that certain characters, especially the relative sizes of the sexes, the degree of development of the femur in relation to the wing, and the relative length and degree of constriction of the pronotum differ greatly in *gregaria* and *transiens* types and afford useful distinguishing characters.

Australian Sponges. The study of the collection of sponges brought home by the Great Barrier Reef Expedition has afforded M. Burton (Sci. Reports Great Barrier Reef Exped., **4**, No. 14, 1934) the opportunity to review our knowledge of the sponges of the Australian region, especially with regard to their nomenclature. 107 species are recorded, 17 of which are new, and five new genera are created. The author points out that species on the Barrier Reef are found also in the West Indies, the Azores and the Mediterranean and that the sponge faunas of the Indian Ocean and the Malay area include many species showing the same distribution. "So far as can be seen at present, the line of their distribution follows through from the Malay area and Indian Ocean, round the most southerly point of the African continent, up its west coast to the Azores and thence into the West Indies on the one hand and the Mediterranean on the other. Moreover, these same species do not seem to occur outside this area. It is possible that a detailed study of this problem may shed interesting light on the migration of species and the factors limiting distribution."

Pollen Constancy of Bees. A useful study entitled "Further Observations on the Pollen Constancy of Bees" by W. H. Brittain and Dorothy E. Newton has appeared (*Canadian J. Res.*, **10**, No. 3, pp. 255–263, March 1934). Several authorities have supposed that hive bees do not gather honey from more than one species of plant at the same time, but the present paper shows that this is not always the case. Whilst bees of the species *Apis mellifica* obtained pollen from one species in 56 per cent of their loads, the remaining loads were mixed, and in a few cases, pollen from four different species was found. Bees belonging to the genera *Andrena* and *Halictus* have a lower degree of constancy than the hive bee. It appears that insects which occur most commonly on apple blossoms have also a wide range of other pollen hosts.

Yield of Rubber from Vegetatively Propagated Clones. Very rapidly the scientific study of vegetative propagation in the tropics is enabling variable material grown from seed to be replaced in the plantations by more uniform plants multiplied by vegetative propagation from selected parents. In the case of rubber, both budded and grafted material has been successfully propagated, and it is significant that the *Journal of the Rubber Research Institute of Malaya* of March 1934 contains papers by Mann, Billington and Kaimal and by Rhodes and Mann, upon the yield of latex from such vegetatively propagated clones. The point seems already established that, as might be expected, the trees of a clone, all multiplied vegetatively from one parent plant, are more uniform in growth habit and show a good correlation between growth in girth and yield of latex. It is found, however, in tapping the new plantations, as yet of very young trees, that the yield of the parent may not apparently be a reliable criterion of its value as a founder of a clone. From a group of 19 trees selected from 500, only 4 have given buddings which appear to possess the necessary high-yielding characteristics. This means that progress may be slow, but none the less it should be sure, and the figures supplied by Rhodes and Mann certainly suggest that there is great uniformity in behaviour in the trees of a clone. As the selected clones are studied, naturally various types are eliminated for reasons connected possibly with other characteristics than yield. This appears to have led to some uncertainty amongst practical growers as to the future of the new methods, but an estimate by C. E. T. Mann of yield under commercial conditions from clone plantations shows that the outlook for the new practice is definitely favourable.

The Genus *Meconopsis*. The *Gardeners' Chronicle* of June 9 contains a useful review of the development of our knowledge of the genus *Meconopsis*, since it was established upon the single species *M. cambrica* in 1814. The increasing popularity of various *Meconopsis* species for garden use has led to the publication of many systems of classification.. Sir David Prain kept pace with the rapidly increasing number of species from 1896 until 1915, and recent plant collecting expeditions have yielded still more material. Mr. George Taylor has published a revision ("An Account of the Genus *Meconopsis*", 130 pp. Flora and Sylva, Ltd., London, 20*s*.), reviewed in NATURE of May 26, p. 777. The group is now divided into four sub-sections: Cambricæ, Eucathcartia, Discogyne and Polychætia. Habit, floral colour and pubescence are the distinguishing characters which separate the sub-groups. Polychætia are further subdivided into Eupolychætia and Cumminsia. The latter group contains the most common garden species, and is arranged in six series: Simplicifoliæ, Grandes, Primulinæ, Delavayanæ, Aculeatæ and Bellæ.

Rhætic Mammals. Some new teeth of the earliest known mammals have been discovered and described by Miss Erika von Huene, who has lately made an exhaustive study of the fossils in the Rhætic bone-beds of Würtemberg (*Jahreshefte Vereins vaterl. Naturkunde in Württ.*, 65–128; 1933). One tooth named *Mucrotherium* seems to belong to a Multituberculate like *Tritylodon*; *Uniserium* is of uncertain relationships; and other unnamed teeth may represent Plagiaulacids and Pantotheria. With these in the Rhætic bone-beds of both Würtemberg and Somerset, there are very small tricuspid teeth, named *Tricuspes*, which probably belong to mammal-like reptiles.

The Noto (Japan) Earthquake of 1933. The Noto peninsula branches off from the north-west side of the Main Island of Japan. A strong earthquake that

occurred in the middle of the peninsula on September 21, 1933, is described by Mr. T. Suzuki (*Earthq. Res. Inst. Bull.*, 12, 44–51; 1934). Though of merely semi-destructive strength—three persons were killed and a number of houses were partially destroyed—fissures occurred in the epicentral area and soft ground subsided locally. The epicentre lay in lat. 37° 4′ N., long. 136° 57′ E. During the following November, the central district was re-levelled (*Bull.*, 12, 52; 1934). Comparing the new heights of the bench-marks with those obtained in August and September 1928, it was seen that the whole area had risen slightly, in one part by 29·0 mm. or 1·14 in.

Alpine Landslips. M. F. Montandon has done most useful work in compiling a catalogue of great Alpine landslips during the Christian era (*Matér. pour l'Étude des Calam.*, No. 32, 271–340; 1933). The tests for a great landslip are that its volume should exceed three million cubic metres, that it should destroy completely a town or several hamlets or villages, or should block up an important valley. The total number of such landslips is 160, the numbers for the last five centuries being 21, 14, 16, 25 and 43. The number of lives lost since 1501 is nearly 4,000, the numbers in 16 landslips ranging from 30 to about 1,200. The largest six landslips, each containing more than thirty million cubic metres, all occurred in secondary or tertiary formations. The number of places destroyed by landslips or the resulting floods amounts to 9 towns, 48 villages and 73 hamlets. M. Montandon gives three maps, of the western, central and eastern Alps, on which the sites of the landslips are marked. These sites are grouped in three well-defined zones, the north-west end of the Alpine arc with Mont Blanc as centre, the basins of the Reuss, Linth, Tessin and Adda with the St. Gothard as centre, and the massifs of the Dolomites and the Hohe Tauern. On the other hand, landslips are rare in two zones, the upper basins of the Durance and Po, and the districts of the Inn and Adige; and they are entirely absent from an extensive area in Austria and Carinthia. More than a quarter of the whole number occurred in seven bands, which altogether form a very small fraction of the Alpine region.

A Theory of the Viscosity of Liquids. In two recent papers (*Phil. Mag.*, 7, 17, 497 and 698) Prof. E. N. da C. Andrade develops a theory of the viscosity of liquids which, unlike earlier attempts, leads to remarkable agreement between calculated and observed values. The liquid state is assumed to resemble the solid much more than the gaseous: the molecules vibrate about equilibrium positions which shift slowly whereas in the solid they are fixed. The frequency is assumed to be the same in both the solid and liquid state, and support is adduced for this view. In a velocity gradient the transfer of momentum between adjacent layers takes place, not as in gases by diffusion of molecules, but by momentary combination of molecules at extreme libration. On these assumptions the viscosity coefficient may be expressed in terms of the atomic weight, the melting point and the atomic volume at the melting point, without an arbitrary constant. The values thus calculated agree very well with experimental data over an astonishingly wide range. The second part of the paper deals with the variation of viscosity with temperature and pressure. The transfer of momentum postulated above occurs only in favourable conditions of energy of the molecules in the intermolecular field, so that the probability of transfer follows the Boltzmann temperature law. On this basis an exponential formula with only two arbitrary constants is deduced, which agrees closely with experimental data for all liquids except water and some tertiary alcohols, anomalous also in other respects. By assuming that the fundamental frequency varies with pressure in accordance with Einstein's compressibility equation, a formula for the variation of viscosity with pressure is obtained which contains no fresh arbitrary constant and agrees with experiment up to about 3,000 atmospheres.

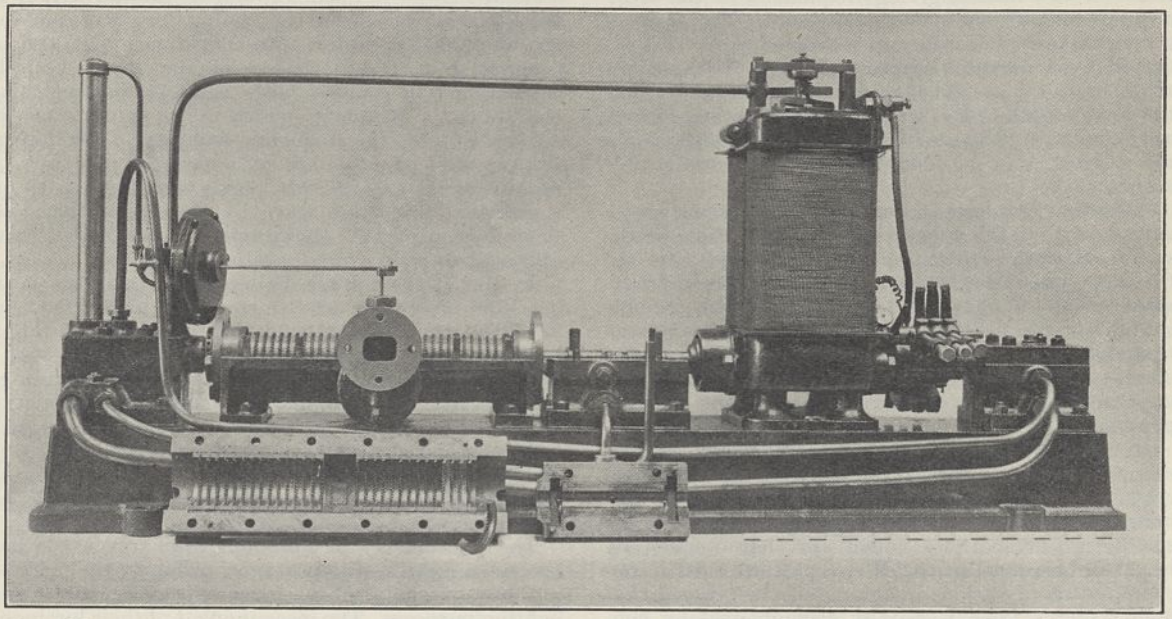
Experiments with Heavy Hydrogen. A. Farkas, L. Farkas and P. Harteck (*Proc. Roy. Soc.*, A, April) have carried out a number of experiments on the equilibrium between the molecular species present in a hydrogen isotope mixture and on the *ortho-para* conversion of the heavy hydrogen molecule. In order to analyse the gas mixtures they use the heat loss from a wire at two different temperatures, the wire being surrounded by the gas sample under low pressure. The variation of specific heat with temperature is at low temperature very different for hydrogen and for diplogen. In contact with a nickel wire at 600°, the molecules H_2, D_2 and HD rapidly come to equilibrium, and thermal measurements made before and after contact with hot nickel enable the authors to determine the HD content of a sample. It was found that the two isotopes tend to separate by diffusion when the mixture is pumped through a fine nozzle; there is, however, no preferential absorption on charcoal. When a mixture diffuses through a palladium tube, there is a preferential transmission of H^1 at lower temperatures and none at higher temperatures. They suggest that this difference arises from different sorption velocities arising from different energies of activation. The *ortho-para* conversion was studied by a similar method to that described above. It was found that the Bose-Einstein statistics applies to the diplogen nucleus, and that the most probable value of the nuclear spin is 1.

Synthesis of the Aldohexoses. When Emil Fischer established the constitutional formula of glucose he was able to forecast the existence of fifteen other aldohexose sugars, differing only in the stereochemical arrangement of their H and OH groups. Fischer set to work to synthesise these—since only four of them occur in Nature—and succeeded in making twelve of the isomerides. Two more, *d*-allose and *d*-altrose, were added in 1910 by Levene and Jacobs consequent on their discovery of *d*-ribose. This chapter of carbohydrate chemistry is concluded by the synthesis, described in the May number of the *Journal of the American Chemical Society* by Austin and Humoller, of the sixteenth and the last remaining aldohexose to be synthesised, *l*-altrose, the same authors having announced the synthesis of *l*-allose some months previously. The epimeric pair were obtained from *l*-ribose by the cyanhydrin reaction, *l*-ribose being produced by the action of perbenzoic acid on the unsaturated arabinal formed from the accessible pentose *l*-arabinose. Both *l*-allose and *l*-altrose were obtained crystalline, and in the same journal Phelps and Bates announce the preparation in crystalline form of *d*-allose, making the ninth aldohexose to be obtained crystalline, the others which have been so obtained being the *d* and *l* forms of glucose, mannose and galactose.

The First Parsons Steam Turbine

THE jubilee of the first Parsons steam turbine and high-speed generator, as we have already noted (NATURE, Jan. 20, p. 97), falls this year. To mark the event, the original turbo-generator, which is preserved appropriately at the National Museum of Science and Industry at South Kensington, has been moved to a prominent position near the main entrance, where it now forms the centre of a special exhibition, which will be continued for several weeks. This also includes copies of the original patent specifications of 1884; a photograph of the portrait of Sir Charles Parsons, who died on February 11, 1931, painted by the late Sir William Orpen; a chronological table detailing numerous steps in the progress of this type of prime mover, now the most important, with which the name of Parsons will always be linked; and a set of transparencies showing a few of the outstanding stages in the fifty years' development of power-generation with the Parsons turbine on land and sea, such as the Forth Banks, Elberfeld, Carville, Barking, Brimsdown and Dunston Power Stations and the *Turbinia*, *Viper*, *Dreadnought*, *Mauretania* and *King George V*, all vessels of outstanding interest.

Fig. 1 shows the original turbo-generator of 1884 which ran at the unprecedented speed of 18,000 R.P.M. and developed about 10 H.P. This small set, less than six feet long, is the direct forerunner of the large reaction type turbo-generators used to-day in all parts of the world, culminating in the 160,000 k.w. pure reaction, cross compound set erected in 1928 at the Hell Gate Power Station, New York.



Copyright] [*Science Museum*

FIG. 1. Parsons' original steam turbine with dynamo, at the Science Museum. The cover of the turbine is lying in front. The broken line on the right represents a 2-ft. rule.

Visitors to the Science Museum are also referred to other early Parsons turbines which are preserved there, notably the 120 k.w. radial flow turbine installed in 1891 at the Cambridge Electric Light Station, the first condensing turbine, which surpassed in efficiency and economy the equivalent reciprocating steam engine; the original radial flow Parsons turbine from the famous S.Y. *Turbinia*, and the after-half of the *Turbinia* itself with the parallel-flow turbines on three shafts which enabled it to attain the record speed of more than 34 knots in 1897.

Annual Visitation of the National Physical Laboratory

ON June 26, the General Board of the National Physical Laboratory made its annual inspection of the Laboratory. Many visitors, including members of scientific and technical institutions, of Government departments and of industrial organisations were present, and were received by Sir F. Gowland Hopkins, president of the Royal Society and chairman of the Board; the Right Hon. Lord Rayleigh, chairman of the Executive Committee; and the director, Sir Joseph E. Petavel.

In the Physics Department several researches are in progress for the benefit of the refrigeration industry. The laws of heat transfer between an air stream and gilled pipes are being studied; the viscosities of various refrigerants are being determined over a wide range of temperatures; and the thermal conductivities of materials used in the construction of containers for solid carbon dioxide are being measured at the working temperatures.

An interesting investigation is the study of the

discharge of air from ports in the side of a duct such as is used in the cooling of a stores. Measurements have been made on the outflow and the direction of discharge from a series of ports in a single duct, and it has been found that the quantity and direction of air issuing from a port depends on its position downstream. For certain ratios of port area to cross-section of duct, the maximum discharge can occur at the port farthest downstream.

In the same Department experiments have been made to determine the specific heat of carbon monoxide up to a temperature of 1900° C. by the velocity of sound method. A quartz crystal in the form of a rectangular parallelopiped is arranged to vibrate in either of two modes, giving frequencies of the order of 8,000 and 27,000 cycles per second. The train of waves generated is sent up a heated tube and reflected by a movable graphite piston; the positions of the reflector at which resonance occurs determine the wave-length of the sound. These positions, which are detected by the reaction of the reflected wave on the crystal, can be determined with considerable accuracy.

Attention has been given to the conditions necessary to secure the highest possible precision in the standardisation of platinum thermo-couples. At the freezing point of gold (1063° C.) considerable improvement has been obtained by immersing the crucible containing the gold ingot in a thermostatically controlled bath of molten silver. The method is being employed for other fixed points on the scale; the apparatus used for standardisation at the freezing point of silver was exhibited.

In the Radiology Division extensive work has been carried out on the application of X-rays to industrial research. A technique has been developed to discriminate between strained crystals and extremely small crystals, both of which are characterised by broad diffuse lines in the X-ray pattern. An X-ray examination of various magnet steels has shown that high coercive force is usually accompanied by considerable lattice strain, while low hysteresis loss is generally associated with a crystal structure free from strain. Work has been continued on the experimental realisation of the X-ray unit of quantity, the röntgen, and the accuracy of its determination at the Laboratory is now of the order of $\pm$ 0·5 per cent. Photographic methods of evaluating X-radiation in röntgens are being studied; and the problem of measuring gamma rays in röntgens, for purposes of radium dosage, is being investigated.

The new Acoustics Laboratory of the Department is now in use and was open for inspection. The new laboratory, which comprises a reverberation chamber and two rooms designed for transmission measurements, together with the necessary auxiliary measurement rooms, provides unique facilities for the study of the absorption and transmission of sound using larger scale specimens of materials than has hitherto been possible. The rooms, which are asymmetric in plan and elevation, and isolated both electrically and acoustically to as high a degree as possible, will facilitate in particular the study of noise transmisson and abatement in relation to the design and construction of walls and floors of modern buildings.

The differential colorimeter developed in the Optics Division for use with transparent materials has proved valuable in the accurate comparison of transparent samples of almost identical colour. Modifications are being introduced to permit similar comparisons to be made between opaque materials. An experimental model of a colorimeter, in which the human eye is replaced by a photoelectric cell in combination with suitable colour filters, was exhibited. The instrument gives promise of great utility in certain branches of colorimetry, and is especially useful for the rapid evaluation in international units of the comparative values of similar colours.

In the Electrical Standards Division of the Electricity Department, a study has been made of the use of the multivibrator circuit for the production of frequencies which are an exact submultiple of those of the standard frequency. The method has been successfully applied to the production of a series of standard audio frequencies, and to the derivation of seconds impulses from the tuning fork without the use of a phonic motor. An investigation is also in progress into the variation of the inter-electrode capacitance of valves with changes in operating conditions, a property which is of importance in connexion with the frequency stability of oscillators. It is worthy of note that in a recent comparison of radio-frequency standards, made simultaneously on a standard broadcast wave by the Laboratory and several continental laboratories, agreement was obtained to within one part in one million.

In the High Voltage Laboratory apparatus is in use for producing and measuring high transient voltages. An impulse generator, capable of yielding voltages up to one million volts, is used in this work; the measurements are made with a high-voltage cathode ray oscillograph. The surge characteristics of insulators, dielectrics, and electrical machines, will be investigated. The work has necessitated the development of control circuits to synchronise the operation of the oscillograph with the impulse to be measured.

The photometry of luminous discharge tubes has become a matter of importance, owing to the increasing use of such tubes, more especially for street lighting purposes. The measurement of their luminous efficiency presents considerable difficulty, because of the marked difference in colour between the tubes and the Laboratory standards of candle power. A study has been made in the Photometry Division of the best methods available for carrying out such measurements.

In the Radio Department methods have been developed for the automatic recording, by radio echo-sounding, of the equivalent height of reflection from the ionosphere. Some of the records obtained were exhibited. The application of the cathode ray direction finder to the location of the place of origin of atmospherics has been investigated. The experience gained at the Radio Research Station, Slough, in the study of these problems has been applied to the design of a compact direction finder for use, at ranges up to ten miles, as a collision preventer in foggy conditions at sea. The equipment comprises two frame aerials, the signals from which are amplified by two identical amplifiers before being applied to the oscillograph. The movement of the spot on the fluorescent screen shows, instantaneously, the direction from which the signals emanate.

The Department has been responsible for extensive work on the electrical properties of soil and liquids, at wave-lengths of the order of 1 metre. A method has been developed involving the investigation of the standing waves on a pair of Lecher wires which are partly immersed in the soil or the liquid. The ratio of the distances between the nodes either of potential

or of current, outside and inside the substance, determines the dielectric constant of the substance.

In connexion with the problem of frequency stability, apparatus has been devised for investigating the variation with temperature of the electrical constants of condensers and inductance coils. The specimens under test are heated artificially with hot air, and their inductance and capacitance are determined by reference to a standard inductor or capacitor the temperature of which is controlled thermostatically.

In the Metrology Department, recent determinations with the wave-length comparator have given values for the yard and the metre in terms of the wave-length of the red radiation from cadmium. The accuracy obtained in the optical measurements of length was from one to two parts in a hundred million. The measurements, which were made both *in vacuo* and in dry air free from carbon dioxide, also gave a value for the refractive index of the air. The apparatus is being used to obtain more precise information concerning the influence of variable atmospheric factors, such as temperature, pressure, humidity and carbon dioxide content, on the refraction and dispersion of air. A new Fabry-Perot interferometer of the variable gap type has been constructed for use in making precise intercomparisons of wave-length under controlled temperature conditions *in vacuo*, and for the examination of possible alternatives to the cadmium radiation.

A new type of free pendulum clock has been developed in the Department. The pendulum, swinging *in vacuo*, is maintained by regular electrostatic impulses controlled by a photoelectric cell to give constant amplitude and very precise seconds signals. An intercomparison of this clock with the other frequency standards will afford valuable information concerning the true behaviour of the various time-keeping devices.

In the Engineering Department, research on the resistance of metals to fatigue stresses occupies an important place. In particular, combined fatigue stresses, such as are encountered in engineering practice, have received attention. A study has been made of the behaviour of similar single crystals of aluminium subjected to reversed bending, to reversed torsion, and to a combination of both types of stress; the results have confirmed the general applicability of the resolved shear stress law. Fatigue tests on various metals *in vacuo* and in air have established that, in general, the exclusion of air increases the resistance to fatigue. Subsequent work, in which both dry and damp air have been used, has indicated that the decrease in strength in air is mainly due to water vapour, acting either directly or as a catalyst.

An investigation into wheel impact is being carried out in the Department on behalf of the Roads Research Board; apparatus has been devised for fitting to self-propelled vehicles of normal design. The measuring equipment consists of electrically recording accelerometers and spring-load gauges, fitted to the rear axle. By means of specially designed electrical circuits, these instruments are made to yield a current proportional to the instantaneous force in either wheel; this current is recorded oscillographically. A six-wheeled lorry equipped for impact tests was exhibited.

The research on the pressure of wind on structures has been extended to include the study of the modification of wind pressure produced on a building by the shielding effect of adjacent buildings; model buildings mounted in a small wind tunnel are being used. In the case of models with roof inclinations of $23\frac{1}{2}°$, it has been found that in general, the stresses on the roof of the shielded building are reduced by the proximity of other buildings. In the case of a building shielded by two others between which there is a narrow gap, it has been found that the suction on the windward side of the roof is even greater than that in the case of a single building freely exposed to the wind. The effect of roof shape is being examined.

The Department is investigating the relative merits of stainless steel and mild steel journals under conditions of ring oiling, and journals made of the two steels have been tested in a journal-friction testing machine. Given similar surface conditions, there appears to be little difference between their performance; the amount of friction appears to depend on the surface condition of the journal. Apparatus employing an optical lever method and capable of high precision has been constructed for studying the roughness of journal surfaces. Curves obtained with it revealed the irregularity of the surface of a polished steel journal.

In the Metallurgy Department, an investigation is being made into the constitution of light alloy systems; for example, magnesium alloys. In this work the addition of cadmium to magnesium alloys has been found advantageous, and a study is being made of the constitution and mechanical properties of alloys of magnesium with cadmium and aluminium. The work on grain size in aluminium castings has been continued; in this connexion the aluminium–titanium system has been examined. Specimen castings of aluminium and aluminium alloys showing the influence of various factors on grain size were exhibited in the foundry. Work is also in progress on the constitution of alloys of iron with reference to the use and properties of special steels. In this connexion the constitution and transformations, in the solid state, of iron rich in manganese are being examined.

A systematic study is being made of the solubility of gases in certain metals, a matter of considerable importance for the soundness of ingots and castings. A molybdenum-wound furnace used for work on gases in iron was exhibited. On account of the permeability of refractory materials to gases, the amount of refractory material in the furnace is reduced to a minimum. The furnace is enclosed in a water-cooled silica vessel.

The influence of surface oxide-film on the free passage of gases into and from molten metals is being examined. A new horizontal electron diffraction apparatus has been constructed for the examination of films in process of formation. The problem of the oxide inclusions in steel is being investigated by two methods. In one method, steel samples are fused *in vacuo* in a graphite crucible, the evolved gases being pumped off and analysed; in the other method, solution in a dry alcoholic solution of iodine out of contact with the air is used.

In the Aerodynamics Department, the research on wing-body interference has reached a stage at which the streamline bodies previously used have been replaced by models of typical aircraft fuselages. Two bodies, of the open cockpit and cabin type respectively, are being studied with and without the airscrews in operation.

Apparatus has been designed in the Department for obtaining the time-history of the rapid change in lift which an aerofoil experiences when the angle of incidence is suddenly altered. Such transient forces

are of importance in connexion with the effect of gusts on wing-load. The angle of incidence of the aerofoil under test is rapidly altered by a spring mechanism; the resulting change of lift on the aerofoil is recorded piezo-electrically.

Much work is being done in the Department on turbulent airflow. Extensive use is being made of shadowgraph methods in which the motion of spots of hot air produced by electric sparks is observed photographically. Apparatus has been devised for obtaining cinematograph records of the air flow, and in this work the *Schlieren* method of photography has proved of assistance.

The equipment of the Department has been augmented by the construction of a high-speed wind tunnel operated from the exhaust of the compressed air tunnel. This tunnel, which is one foot in diameter, is expected to give wind speeds in the neighbourhood of 950 ft. per second. The tunnel is to be used for the study of the behaviour of aerofoils at high wind speeds, with particular reference to the aerodynamic efficiency of the tip sections of airscrews at high speeds.

The William Froude Laboratory is engaged on extensive research on the manœuvring of ships. The work has shown that in certain cases, the performance of a rudder can be considerably improved by an alteration in propeller design. The effects of introducing a fin in front of the rudder are being investigated in the case of single-screw ships. A model of a single-screw vessel equipped with apparatus for measuring steering qualities was exhibited.

For research on propeller efficiency, a 24 ft. wooden model of a single-screw cargo ship has been constructed, complete with self-propelling gear and automatic recording apparatus for measuring the thrust capacity of propellers. The model is available for testing propellers of any design. A closed circuit tunnel for research on model propellers—the gift of Sir James Lithgow—has been added to the Department. The new tunnel will facilitate the study of the action of propeller blades, with particular reference to the cause of erosion. Stroboscopic methods are provided for observing the propeller while it is in motion.

Jubilee of the Junior Institution of Engineers

THE Junior Institution of Engineers celebrated its jubilee on June 27–29. The Institution was founded in 1884 by a group of young engineers employed at the works of Messrs. Maudslay, Sons and Field of Lambeth, and it has always fostered "the Junior spirit". Open to men of all ages engaged in any branch of engineering and allied professions, it demands no examination of its members, and its meetings and discussions are marked by an absence of formality. Its first president was Mr. Freke Field, a grandson of Joshua Field (1787–1863), the partner of Henry Maudslay, who himself in 1818 was the first chairman of the newly founded Institution of Civil Engineers, and its president in 1848. The successors of Mr. Freke Field have included the late Sir Alexander Kennedy, John Perry, Silvanus Thompson, Sir William White, Lord Moulton, Sir Dugald Clerk, and many other distinguished men still living, eleven of whom were present at the luncheon at the Hotel Victoria on June 27 with which the jubilee proceedings were inaugurated, and at which Mr. W. J. Tennant, the present president, presided.

The luncheon on Wednesday was followed by a special service in St. Paul's Cathedral attended by the Institution as "an act of thanksgiving for 50 years of steady progress and attainment"; a reception at the Mansion House by the Lord Mayor and Lady Mayoress, and a conversazione at the Science Museum, South Kensington. A special exhibition of models, tools and drawings relating to the Lambeth firm, and to men who had been associated with it, had been arranged, and during the course of the evening an illustrated lecture on Maudslay, Sons and Field and the Royal Navy, was given by Eng.-Capt. Edgar C. Smith. After a brief reference to the formation of the institution and the world's great debt to young inventors and engineers, of which there were many notable illustrations in the Museum, Capt. Smith said that the history of the firm of Maudslay is of interest for many reasons; first, because of the many eminent engineers who built up its fortunes and maintained its traditions; secondly, on account of its work as a training school for mechanical engineers; thirdly, because it recalls a time when marine engineering was a flourishing industry on the Thames, carried on not only by Maudslays but also by Penn, Humphry, Miller, Ravenhill, Rennie, Seaward and others; and lastly, as the firm which during the nineteenth century supplied more marine machinery to the Royal Navy than any other.

The first vessel engined for the Navy by Maudslays was H.M.S. *Lightning*, 1823, and she was succeeded by such notable vessels as the *Rhadamanthus*, the first steam man-of-war to cross the Atlantic, the *Terrible*, the largest paddle wheel frigate, the *Rattler*, the first steam screw-driven man-of-war, the *Marlborough*, the *Iris and Mercury*, the *Blake* and many others. In all the various changes and advances in marine propulsion, Maudslays played a great part, and the last engines constructed by them represented the highest pitch of mechanical engineering during the nineteenth century.

The events of Thursday included a visit to the Cricklewood works of Smith's English Clocks Ltd., and the delivery by Sir Frank Smith, secretary of the Department of Scientific and Industrial Research, of the Gustave Canet Memorial Lecture of the Institution at the Royal Society of Arts. This lecture was founded by Madame Canet, the widow of Gustave Canet (1846–1908), the distinguished French ordnance engineer who died while he was holding office as president of the Institution.

Sir Frank Smith took as his subject "The Engineer and Modern Civilisation". The structural engineer of early times, he said, carrying out great works without a knowledge of science, either consciously or subconsciously followed the principles which Nature pursues in creating our own structures. The engineer of to-day is distinguished from his predecessor inasmuch as he studies structures of microscopic size as well as those of gigantic proportions, and in this way is able to improve his materials and discover new ones. Modern civilisation, he continued, is a blend of two cultures: the engineering culture embracing the sciences, industry and commerce, and an idealistic culture including the fine arts and philosophy. What distinguishes so markedly our modern civilisation from that of a hundred or even fifty years ago is that

the materialistic culture is much more advanced than ever before.

The composite work which makes up our civilisation looks quite different when seen through the spectacles of an electrical, civil or mechanical engineer. The first would point to the vast output of electrical machinery and appliances, the second to the great railways, bridges and dams, and the last to inventions which made possible the developments of tools and machines. It was Maudslay's slide-rest lathe and Whitworth's accurate straight-edges and surface-plates which made it possible to construct the modern internal combustion engine.

There is also a picture of labour displaced by machinery; sweeping economies in labour being made in factories, mills and offices. With mechanical equipments on farms, 1,000 acres can be ploughed, prepared and sown in a single day, and ten minutes of human labour suffices to produce a bushel of wheat whereas formerly three hours were required. The pleasant picture of the English country-side a century ago with its hay wains and reapers was accompanied by another of long hours and child labour in factories. The engineer by his inventions has made child labour unnecessary and farm work less exacting; many who pine for 'the good old days' labour under deceptions similar to those which often mislead travellers in tropical countries—they see mirages of oases in plenty in the rear while the real oases lie right ahead. Stuart, more than a century ago, estimated that the steam engines in use in Great Britain developed more power than 4,500,000 labourers; to-day, steam turbines develop more power than 450 millions of Stuart's labourers, while in the United States it is estimated that every individual has an average of 900 such 'slaves'. The engineer, too, has banished the fear of famine; he has supplied fertilisers for the soil, agricultural machinery of wonderful efficiency, transport facilities of remarkable speed, and cool controlled atmospheres for keeping food fresh and palatable over long periods. At the conclusion of his lecture, Sir Frank Smith was presented with the Gustave Canet Gold Medal.

University and Educational Intelligence

BIRMINGHAM.—On June 30 the honorary degree of LL.D. was conferred on the following, among others: The Right Hon. the Earl of Derby, Chancellor of the University of Liverpool; Sir John Cadman, emeritus professor of mining in the University, chairman of the Anglo-Persian Oil Company; Sir Harry McGowan, president and chairman of Imperial Chemical Industries, Ltd.; Dr. G. T. Morgan, director of the Chemical Research Laboratory, Teddington; Prof. C. A. Lovatt Evans, Jodrell professor of physiology, University College, London.

THE following appointments have been made: Philip Cloake, joint professor of medicine, to succeed Prof. J. G. Emanuel who has resigned; J. M. L. Burtenshaw, lecturer in bacteriology; T. G. Hunter, assistant lecturer in oil engineering.

CAMBRIDGE.—In the annual report of the Committee of Management of the Scott Polar Research Institute it is stated that the formal opening of the new buildings will take place in the autumn, probably on November 16, when the Chancellor of the University (Mr. Stanley Baldwin) has consented to perform the opening ceremony.

The Harkness Scholarship, valued at £150, awarded for proficiency in geology, has been won by J. K. S. St. Joseph, Bromsgrove and Selwyn. The Wiltshire Prize for geology and mineralogy in connexion with Part I of the Natural Sciences Tripos has been awarded to S. O. Agrell, Bedales and Trinity Hall.

The Frank Smart Prizes have been awarded to G. C. Evans, St. John's (botany), who was placed in Class I in Part 2 of the Natural Sciences Tripos and A. L. Hodgkin, Trinity (zoology and comparative anatomy), who was placed in Class I in Part 1 of the same tripos.

At Magdalene College D. Purdie Kings has been elected to the Charles Kingsley bye-fellowship.

At St. John's College the following have been elected into fellowships:—Dr. M. L. O. Oliphant, of Trinity College, Messel research fellow of the Royal Society, and O. A. Trowell, formerly scholar of St. John's College, University demonstrator in physiology.

DURHAM.—At the June Convocation held on June 27, the honorary degree of D.Sc. was conferred on Prof. A. Fowler, professor of astrophysics in the University of London.

EDINBURGH.—On June 28 the honorary degree of LL.D. was conferred on the following, among others: Dr. Robert Hutchison, physician to the London Hospital; Prof. Robert Robinson, Waynflete professor of chemistry in the University of Oxford; Dr. Theobald Smith, emeritus director of the Department of Plant Pathology, Princeton, New Jersey, former director of the Rockefeller Institute; Sir John Maxwell Stirling-Maxwell, formerly chairman of the Forestry Commission and chairman of the Ancient Monuments Board (Scotland); Prof. D'Arcy Wentworth Thompson, professor of natural history in the University of St. Andrews.

The degree of D.Sc. was conferred on the following for the theses indicated: G. H. Bates ("Semi-Natural Vegetation and the Biotic Factor"); Charles Ockrent ("Studies in Active Charcoal"); C. M. Scott ("The Sensitivity of Cells to the Lethal Action of X-Rays"); George Taylor ("An Account of the Genus *Meconopsis*"); Dr. S. A. Kinnier Wilson ("The Experimental and Applied Physiology of the Corpus Striatum").

LONDON.—The Kent County Council has decided to make a grant of £40,000, payable over ten years, towards the cost of erecting new University buildings on the Bloomsbury site, and the Worshipful Company of Butchers has made a grant towards the Ceremonial Hall.

ST. ANDREWS.—On June 29, the honorary degree of LL.D. was conferred on the following, among others: Lord Moynihan, emeritus professor of surgery in the University of Leeds; and Sir Frederick Gowland Hopkins, president of the Royal Society.

MR. IVOR GRIFFITHS and Mr. P. Jacobs have been awarded Streatfeild scholarships under the Royal College of Physicians and the Royal College of Surgeons to carry out an investigation into the tonsil, its anatomy, physiology, and the relations of its lymphatic vessels.

Science News a Century Ago

Launch of S.S. *John Randolph*

On July 9, 1834, the *John Randolph*, the first iron steam vessel in the United States, was launched on the Savannah River. She had been built by John Laird at Birkenhead and sent to the United States in sections. She was 110 ft. long, 22 ft. beam, and drew about 2¾ ft. Her tonnage by the builders' old measurement rules was about 250 tons. Her engines, of 60 horse-power, had been made by Fawcett, Preston and Co., of Liverpool. The first iron vessel had been built so long before as 1787, but iron shipbuilding made slow progress. There were many objections raised against the use of iron, but practical experience proved most of them to be ill-founded. In the end, iron ships proved lighter and faster than wooden ships, cargoes could be stored more easily and kept in better condition in them, they were more easily repaired, and when fitted with watertight bulkheads were far safer. The pioneers of iron shipbuilding in Great Britain included John Grantham, Sir William Fairbairn and David Napier, but none did more important work in this direction than John Laird.

Death of Capt. David Thompson

"We have just received the intelligence," said the *Athenæum* on July 12, 1834, "of the decease at Mauritius of the well-known computer and author of the Lunar and Horary Tables and inventor of the Longitude Scale, in consequence of severe injuries received during the hurricane which recently devastated that colony.

"The work which brought Captain Thompson's name into notice among men of science, is his solution of the problem, of clearing the apparent distance of the moon from other celestial bodies, from the effects of parallax and refraction—one of the most useful in nautical astronomy; and he received from the late celebrated Baron de Zach, high commendation for his skill and success in this investigation, and from the late Board of Longitude, a tardy acknowledgement of the high merit of his Tables. . . ."

David Douglas, 1798–1834

On July 12, 1834, David Douglas, the Scottish botanical collector who discovered 'Douglas spruce', was killed in the Sandwich Islands. On an excursion he inadvertently fell into a pitfall set for wild cattle and was gored to death by a bull. Born at Scone in Perthshire, the son of a stone-mason, he became a gardener, and while employed at the Botanical Gardens, Glasgow, attracted the attention of J. W. Hooker, then professor of botany, and accompanied him on some of his expeditions. He was recommended to Sabine, the secretary of the Royal Horticultural Society, and sent to the United States, where he procured many fine plants. Sent out again in 1824, during the next three years he went as far as north California and the River Columbia, and then made his way to Hudson's Bay, whence he returned with Sir John Franklin. It was during this expedition that he discovered the spruce which bears his name. His third and last expedition began in 1829. After spending a part of the years 1832–34 on the Fraser River, he sailed for the Sandwich Islands. It is said he introduced into Great Britain fifty-three new woods and one hundred and forty-five new herbaceous plants of a hardy nature. He was a fellow of the Linnean, Geological and Zoological Societies and after his death the botanists of Europe erected a monument to him at Scone. A monument to him was also erected in the cemetery at Honolulu by J. L. Brenchley (1816–73), the traveller.

Societies and Academies

LONDON

Royal Society, June 28. W. L. BRAGG: The structure of alloys (Bakerian Lecture). An alloy phase has two characteristics. The first is the pattern of sites occupied by atoms irrespective of their nature. Each phase of an alloy system has a different pattern of sites, and therefore a change from one phase to another involves their complete re-arrangement. The second characteristic is the distribution of the atoms amongst these sites. This distribution may vary continuously without change of phase, from being random at high temperatures to being partially regular at low temperatures. The alloy is a system of dynamical equilibrium. Although interchange of atomic position at room temperature is infrequent, the alloy has received its character at some previous point in its history when the temperature was just sufficiently high for interchange to be important. Maxima and minima in physical properties at certain relative proportions, such as Fe_3Al and $AuCu_3$, are statistical effects, and do not imply the existence of corresponding compounds.

Royal Meteorological Society, June 20. SIR NAPIER SHAW: The natural history of weather. The paper describes an arrangement of the meteorological data for a station with special reference to the encouragement of the study of Nature. I. S. ASTAPOWITSCH: Air waves caused by the fall of the meteorite on June 30, 1908, in Central Siberia. The results of the barograph records obtained by the author at the time of his research expeditions of 1930 and 1932 are given. The time of fall of the meteorite and the force of the explosion were determined by examination of various independent sources. The air wave must have been recorded by microbarograms in Japan, China, India and perhaps America. F. J. W. WHIPPLE: Phenomena related to the great Siberian meteor. This paper is supplementary to one published by the author in 1930. Additional evidence with regard to the illumination of the sky during the nights following the arrival of the meteor is summarised. In view of the fact that recorded observations of this phenomenon are confined to the north of Europe, the meteor probably had a tail which was to be captured by the earth's atmosphere. The air waves produced by the meteor were recorded at Batavia and at Washington as well as at several places in Europe. S. E. ASHMORE: The splashing of rain. The connexion between the rate of rainfall and the splashing produced by it from a horizontal surface has been studied experimentally for a large number of surfaces which may be used as the surroundings for rain-gauges. The splashing from ice and water has also been investigated. W. R. BALDWIN-WISEMAN: The cartographic study of drought. This paper presents a method of setting out rainfall statistics for drought periods. In order to illustrate this method the famous drought in Queensland during 1902 has been investigated. Maps are

given defining the progress of this drought, the rainfall being expressed as deficiencies from the average for groups of consecutive months.

PARIS

Academy of Sciences, May 14 (*C.R.*, 198, 1729–1820). Gustave Moussu was elected a member of the Section of Rural Economy in succession to the late E. Roux. KAROL BORSUK: The idea of the category of L. Lusternik and Schnirelmann. SPYRIDION SARANTOPOULOS: The existence of holomorph integrals of differential equations of the first order in singular cases. BEPPO LEVI: Ensembles of points which cannot be ensembles of zeros of an analytical function of several variables. ANTONIO MONTEIRO: Additive nuclei in the theory of integral equations of Fredholm. ANDRÉ WEIL: A characteristic property of groups of finite linear substitutions. ELIE CARTAN: Remarks on the preceding communication. STEFAN BERGMANN: Integral and meromorph functions of two complex variables. MLLE. M. RENATA FABBRI: Isoconic rotations. P. SWINGS and B. EDLÉN: The presence of the forbidden lines of Ne V in the spectra of nebulæ. R. MAZET: A new definition of the forces of control. HENRI PONCIN: The sudden local variations of density in fluids in motion. J. BERNAMONT: The fluctuations of resistance in a metallic conductor of small volume. M. GUILLOT and M. HAÏSSINSKY: The effect of strong concentrations of electrolytes on the potential of the deposit of polonium. A. MICHEL-LÉVY and H. MURAOUR: The luminosity of waves of shock. A luminous effect (shown in reproductions of photographs) is produced when two shock waves meet and also when a single shock wave meets an obstacle. The spectrographic study of this phenomena is being investigated. MLLE. CÉCILE STORA: The relation between the curve of spectral sensibility and the curve of absorption in photocells with colouring matters. By comparison of the sensibility and absorption curves, it is shown that the photosensitive layer is formed of a very thin pellicle of colouring matter. The energy absorbed by this pellicle is responsible for the variation of potential under the action of light. MME. BRANCA EDMÉE MARQUES: The fractional precipitation of radiferous barium sulphate. A study of the behaviour of the system barium – radium sulphate under different conditions of precipitation. The errors due to filtration are avoided by the use of the centrifuge. The Doerner and Hoskins law holds for the case of slow precipitation. The fractional precipitation of radiferous barium salts by sulphuric acid is less efficient from the point of view of the separation of the radium than the fractional crystallisation of the bromides and chlorides. J. PERREU: The thermochemistry of aqueous solutions of nickel sulphate. MLLE. M. G. ADOLFF and H. HERING: The heterogeneous equilibria in the system: cadmium chloride, sodium chloride, water. A. P. ROLLET and J. WOHLGEMUTH: Study of the binary system: water, lithium hydrazoate. HENRI MULLER: Applications of the method of the lowering of eutectic points. WILFRIED HELLER: The conditions of a mechanical coagulation. IVAN PEYCHÈS: Contribution to the study of beryllium tartrate. The results of measurements of the rotatory power. ANDRÉ DE PASSILLÉ: The method of preparation of pure arsenic. Ammonium arsenate, after purification by repeated recrystallisation, is reduced by heating in ammonia at 1,000° C. and freed from traces of the oxide by sublimation. The arsenic thus obtained proved to be spectroscopically pure. GEORGES DENIGÈS: A new reaction of cantharidine, applicable to its estimation by colorimetry. The method is based on the brown coloration produced by heating with formol and sulphuric acid. E. M. BELLET: The alcoholysis of glycerol triacetin in weak alkaline solution. HENRI RAVIER: Phenyltrimethylglycerol and some chlorhydrins of tetrasubstituted glycerols. A. ABLOV: The influence of the electric moment on the number of molecules of base fixed by a salt. C. LEFÈVRE and CH. DESGREZ: Contribution to the study of the organic sulphides. MICHEL FLANZY: The formation of formaldehyde in the oxidation of ethyl alcohol. The production of formaldehyde as an oxidation product of pure ethyl alcohol is proved: the presence of methyl alcohol is not proved by this reaction. MLLE. SIMONNE CAILLÈRE: Observations on the chemical composition of the palygorskites. RAYMOND FURON and CONRAD KILIAN: The Primary and Cretaceous between Tibesti and Aïr. J. GAUZIT: Concerning the theoretical discussion on the distribution of ozone in the atmosphere and the *Umkehreffekt*. J. VELLARD: The periodic destruction of the fauna of the rivers of the Grand Chaco by variations of salinity. The fish die as the salinity increases through evaporation and are deposited in enormous blocks. This is of interest from the geological point of view as it gives a possible explanation, better than any other hypothesis, of the formation of certain banks of fossil fishes, the origin of which is otherwise difficult to understand. ALPHONSE MALAQUIN: New observations on the germinal strain of the annelid *Salmacina Dysteri*. MLLE. M. L. VERRIER: The action of light on visual purple. The decolorising action of light is only appreciable if working with retinas poor in visual purple or on very dilute solutions: if the visual purple is abundant the action is practically nil. These results are difficult to reconcile with the current view of the mechanism of the visual purple. JACQUES POCHON: The influence of the culture medium on the biological properties of a cellulolytic bacterium from ox stomach. BORDIER: The measurement of the lucimetric index of a given place by a helio-chromometer. The measurement is based on the amount of iodine set free from a solution of iodoform in chloroform. B. S. LEVIN: The influence of oxygen on the antitoxic action of cholesterol on the saponins. MICHEL POLONOVSKI, PAUL BOULANGER and GASTON BIZARD: The formation of ammonia at the expense of amino-acids in the kidney of the dog *in vivo*. An important proportion of the urinary ammonia arises from the natural aminoacids.

LENINGRAD

Academy of Sciences (*C.R.*, No. 7). S. BERNSTEIN: The linear quasi-continuous chains of Markov. I. VINOGRADOV: Distribution of primitive roots. S. MICHLIN: Dirichlet's problem for a domain with several closed boundaries. D. SHERMAN: A problem of the theory of elasticity for domains with multiple connexions. A. POPOV: A note to the paper by V. Fock "Zur Berechnung des elektromagnetischen Wechselstromfeldes bei ebener Begrenzung" (*Ann. Phys.*, 17, 4; 1933). V. PAJEVSKIJ: A general expression for the probability of survival under the mortality conditions of a given calendar period. For practical computation, the following formula may be used:

$$q_{12}^2 = q_{12} - 2 \cdot 4 \frac{l}{n} (6q_2 - q_{12}),$$

where q_2 and q_{12} denote the values of probabilities of dying before the age of 2 and 12 months respectively, l the monthly increase in the number of births, and n the average monthly number of births. M. BRONSTEIN: The relativistic generalisation of the principle of uncertainty. G. KRUTKOV: Contribution to the theory of Brownian movement. On the function $f(v,x,t)$ and the equation of the diffusion. V. KUZNETSOV, D. KONVISAROV and V. STROKOPYTOV: The increase in the plasticity of metals during plastic twisting in alternating directions. K. ANDREJEV and J. CHARITON: Some considerations on the mechanism of self-propagating reactions. A certain minimum degree of localisation of the reaction energy is necessary for the self-propagation of the macrochain. M. KAZNELSON and M. KABACHNIK: Amidation with the help of sodium and potassium amides in the alkaloid series (1). On the α-aminoanabasin. V. SADIKOV, V. VADOVA and R. KRISTALLINSKAJA: The use of H_2SO_4, HCl, H_3PO_4, HNO_3 and of alkalis in the catalytic splitting of proteins. I. LIASCHENKO: Flowering in the genus *Cucurbita*. Description of hermaphrodite flowers observed in four different species. N. KALABUCHOV: 'Anabiosis' in vertebrates and insects at a temperature below zero. At temperatures of −3° to −10° C., metabolic exchange continues, though very slowly; consequently, the state of prolonged undercooling is only a profound torpor, and not a complete cessation of the vital processes understood by 'anabiosis'. L. VARDANIANC: On the age of the surface relief of Ciscaucasia. The conformation was produced only in the post-Pliocene.

ROME

Royal National Academy of the Lincei, Jan. 21. S. MINETTI: Riccati's differential equation and certain results in differential geometry. A. MYLLER: The flexion of scored surfaces. L. SOBRERO: A new hypercomplex variable of interest in the theory of elasticity (1). R. CACCIOPPOLI: Elliptic equations with partial derivatives, with n independent variables. Various simple fundamental results concerning linear equations of elliptic type are established. E. BOMPIANI: Determination of the hyperspacial surfaces for a triply infinite system of normal rational curves. R. ZAÏCOFF: Generalised wave mechanics. F. P. MAZZA and L. PANNAIN: Mechanism of the action of histozyme. This enzyme is distinguished from the carboxypeptidases, as it unites, not with the free carboxyl group of the substrate, but with the nitrogen of the CO.NH bridge. The different activities it shows towards aliphatic and aromatic alcyl derivatives are probably due, not to the existence of two different enzymes, but to varying velocity of the hydrolysis catalysed by the enzyme. F. PIRRONE: (1) Studies on indones. Synthesis of β-phenyl-1 : 2-naphthoindene-11-one. (2) Investigations in the field of high frequency. Biochemical action of ultra-short electromagnetic waves (1). Exposure of brewers' yeast in aqueous suspension to the oscillations of a Hertzian resonator capable of oscillating on the fundamental wave of $\lambda = 1{\cdot}885$ metre reveals a slow accelerating action on the development of the yeast. The effect is slight after 1–2 days, but becomes marked after 6–7 days. G. BINI: Determination of the characteristic nitrogen groupings in the muscular tissue of *Mullus barbatus*, L. The proportions of the total nitrogen of this tissue existing as lysine, histidine, arginine, etc., have been determined by the van Slyke method. C. SIBILIA: Sexuality in certain species of the genus *Chaetomium*. This genus includes many homothallic species, and experiments are being made to ascertain if such homothallism is absolute or prevalent. A. DE AGAZIO: Action of strychnine and strophantine on the isolated heart of *Bufo vulgaris*. ELENA J. ROLAND: Existence of a large sebaceous gland in the external auditory canal of native *Mus* species.

Forthcoming Events

ROYAL SANITARY INSTITUTE, July 9–14.—Health Congress to be held at Bristol. Dr. Stanley H. Badock: President.

INSTITUTION OF NAVAL ARCHITECTS, July 10–13.—Summer meeting and International Conference on Experimental Tank Work. Right Hon. Lord Stonehaven: President.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES, July 11–14.—Annual Congress to be held at the University of Reading.

July 11, Prof. H. L. Hawkins: "Fossils and Men" (Presidential Address).

July 13, Prof. E. B. Poulton: "The Power of Changing Colour as a Form of Protective Resemblance" (Public Lecture).

INTERNATIONAL FEDERATION OF EUGENIC ORGANISATIONS, July 18–21.—Biennial Conference to be held at Zurich.

Prof. Ernst Rüdin: "Racial Psychiatry—a Scheme for Topographical Research in Europe" (Presidential Address).

Official Publications Received

GREAT BRITAIN AND IRELAND

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1934 June 2. Pp. 22. (Greenwich.)

Report for 1932 (No. 41) on the Lancashire Sea Fisheries Laboratory at the University of Liverpool. Edited by Dr. R. J. Daniel. Pp. 133+2 plates. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd.) 5*s*.

Imperial Institute. Annual Report 1933, by the Director, Lieut.-General Sir William Furse, to the Board of Governors. Pp. 56. (London.) 2*s*.

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1933. Pp. 24. (London: H.M. Stationery Office.) 6*d*. net.

OTHER COUNTRIES

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Hors Série. Résultats scientifiques du voyage aux Indes orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. Publiés par V. Van Straelen. Vol. 2, Fasc. 9: Paraperipatus Leopoldi nov.nom. By E. Leloup. Pp. 16+1 plate. Vol. 2, Fasc. 10: Trématodes. By Robert Ph. Dollfus. Pp. 16+2 plates. Vol. 3, Fasc. 8: Rhizocéphales. By H. Boschma. Pp. 8+1 plate. Vol. 3, Fasc. 9: Terrestrial Isopods. By H. Gordon Jackson. Pp. 8+2 plates. Vol. 3, Fasc. 10: Cirripedes (additional part). By Dr. C. A. Nilsson-Cantell. Pp. 8. Vol. 3, Fasc. 11: Ascidies. By H. Harant and Od. Tuzet. Pp. 6. Vol. 4, Fasc. 1: Heterometabola I. Pp. 85. Vol. 4, Fasc. 2: Neuroptera. Pp. 15. Vol. 4, Fasc. 8: Heterometabola III. Pp. 70+3 plates. Vol. 4, Fasc. 9: Coleoptera II. Pp. 57+1 plate. Vol. 5, Fasc. 2: Reptilia. By L.-D. Brongersma. Pp. 39+4 plates. (Bruxelles.)

Suomen Geodeettisen Laitoksen Julkaisuja. No. 19: The Continental Undulations of the Geoid. By R. A. Hirvonen. Pp. 89. (Helsinki.)

Reports of the Institute for Science of Labour. No. 19: Studies on the Hardness of Human Muscle, with special reference to its Value for measuring Industrial Fatigue. By Dr. Gitô Teruoka and Dr. Syôzô Eda. Pp. 9. 30 sen. No. 20: An improved "Rôken" Gas Analysis Apparatus. By Dr. Misawo Okuyama. Pp. 9+1 plate. 30 sen. No. 21: Labour Physiological Studies on the Pregnant Women. By Dr. Gitô Teruoka. Pp. 31. 60 sen. No. 22: Variations in the Physico-chemical Nature of Urine of Workers in Day and Night Shifts, by Dr. Takatugu Yagi and Miss F. Matubara; Physico-chemical Study on the Urine of the Working Girls in a Spinning Factory, by Sho Sasaki. Pp. 16. 30 sen. No. 23: Infant Mortality in relation to the Climate of Japan, Part 1. By Dr. Tujiwo Iwasaki. Pp. 18. 40 sen. (Kurasiki.)

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