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CONTENTS

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Archæological Exploration in the East

"What songs the *Sirens* sang or what name *Achilles* assumed when he hid himself among women, though puzzling questions are not beyond all conjecture. What time the persons of these Ossuaries entred the famous Nations of the dead, and slept with Princes and Councillors, might admit a wide solution. But who were the proprietaries of these bones, or what bodies these ashes made up, were a question above Antiquarism."

So wrote Sir Thomas Browne nearly three hundred years ago. To-day, while the Sirens' song is still a subject for argument—witness recent discussion on the character of ancient music—it would be possible to tell Sir Thomas Browne nearly as much of the urns which moved him to eloquent meditation and their makers as he could have learned about the pots which, doubtless, came to pieces in the hands of his kitchen maids. In the interval between the seventeenth century and the twentieth, study of the remote past—remote, that is, in the human sense—has travelled a long road. The story of the urn is no longer food for the philosophic speculation of the scholar, its form and decoration a theme for the æsthetic appreciation of the dilletante. Their tale is told in the inferences of the prehistorian, whose conclusions, if subject to the constant revision inevitable in a field of growing knowledge and ever more informed interpretation, is set upon a basis of assured knowledge, a body of fact collected, collated and recorded with the nearest possible approach to a high standard of scientific accuracy.

The life of man has many facets ; and the study of man can neglect any one of them only at the price of a distorted picture. Full understanding of the life of ancient Greece and Rome did not begin until their literature was interpreted in the light of the monuments, and still more of the common objects of everyday use revealed by the spade in the streets, shops, dwelling-places and cemeteries of the buried cities of classical sites. On the other hand, prehistoric archæology, relying necessarily on the material products of human activities—tools, weapons, utensils, and in the later phases, the dwelling-places of man and god—must often fail, in the absence of written records, to throw light on the causes and on the sources of crucial developments in cultural history, which initiate further advance in the progress of civilisation.

It is only at the dawn of history and in certain centres of civilisation that contemporary written records, not yet all completely decipherable, give

aid to the archæologist in the interpretation of the evidence of his excavations. When he looks to tradition, it is a nice question on which side lies the greater obligation; for while tradition may afford a clue to interpret a break in the sequence of cultural material or the evidence of a conflagration, tradition may more often find corroboration in the explorations of the archæologist. Thus we may conclude, for example, from the story of the final catastrophe at Jericho, of the dynasties of Ur, and most convincingly of all from the cultural and dynastic background which is now known to lie behind the traditional power of Minos of Crete.

The importance of the Near East in the history of cultural development is passing into a commonplace. There is no other area in the whole world in which the story of the rise of man from primitive beginnings to the complexities of life in a highly organised city community can be traced with the continuity and the completeness of understanding that is possible here. However much future exploration may bring modification of detail, the picture which is emerging with rapidly increasing clearness, as the result of recent archæological exploration, is one in which can be seen the main outlines of the Ancient East as one vast archæological province, extending from the Mediterranean to India, in which locally developed civilisations came into intimate contact, influenced and sometimes absorbed or even overwhelmed one another.

Great movements, such as the rise of the Kingdom of Hammurabi, the incursion of the Kassites into Mesopotamia and the Aryans into India, the ebb and flow of the Hittite and Egyptian Empires on the borders of Syria and Palestine, are in some ways less impressive, perhaps because of a type more familiar, than the evidences of Sumerian influence in prehistoric India, the penetration of Mesopotamian commerce and commercial methods to Hittite lands in the third millennium B.C. and the mixture of peoples and cultures which emerges from the material recently unearthed in Syria at Ras Shamra. Much as we may be impressed by the mass of historic detail, which has been recovered and pieced together with a coherence which would have seemed unattainable little more than a generation ago, it is always the unbroken range of evidence for the rise of man from a stone-using savage to citizenship of a world-wide empire—as the world then was—with all that it implies of material and moral advancement, to which we here return time and again with renewed interest.

Archæological exploration in the past has been much of an adventure in a strange country, in which no one has known what the turn of the next corner might not bring forth. Our knowledge of early civilisations of Bible lands was in the first place a by-product of the search for evidence to support scriptural texts; and although Ur had been the site of previous excavation, no one had anticipated a find such as that of the Tombs of the Kings with their wealth of artistic material and the light they have thrown on the cult of the royal dead in ancient Sumeria. Now, however, the day of isolated and unco-ordinated exploration is passing, if it has not already gone. The number of expeditions which take the field at the beginning of each season is greater than ever before; and each has a clear conception of what it expects, or hopes, to find. The correlation of results, from time to time, not only gives a picture covering a wider area than formerly; it has also revealed the strategic points in time and space at which evidence is most needed at any given moment—and where it is most likely to be found. It was this, to take a single instance, which gave special significance to the results obtained by Mr. E. L. Mallowan at Arpachiyah. Following immediately on the excavations at Nineveh, they supplied welcome data to bring northern Iraq into line with the evidence from early sites in India, to the south and in the Ægean.

Archæological exploration on a basis of reasoned direction has peculiar advantages in the East, where geographical conditions can be readily interpreted in terms of influence on human activities; but it is difficult of full attainment where a number of expeditions under independent control are at work. The advantages of organised research on a number of sites under unified direction are well exemplified in a report, which has been prepared by Prof. J. H. Breasted, for a survey of the activities of the University of Chicago now in progress. This report* deals with the work of the Oriental Institute of the University, an institution of which Prof. Breasted himself was the founder and is the inspiration. He here describes both the field-work and the research which is being carried on within the four walls of the Institute, or by scholars from outside who are associated with its organisation. Archæologists will appreciate the

* The Oriental Institute. By James Henry Breasted. (University of Chicago Survey, Vol. 12.) Pp. xxiii+455+2 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1933.) 13*s.* 6*d.* net.

generalship of the field work, while envying the financial resources which have made it effective. The campaign has been planned to occupy such a series of strategic points in Egypt and western Asia as will give the maximum effect, not only in elucidating decisive epochs of the historical succession of events, but also crucial phases in the development of culture and the rise of man.

At the time of the preparation of Prof. Breasted's report, the Oriental Institute had been responsible for thirteen 'undertakings' in the field, of which twelve are still in operation. Of these, six are in Egypt and north-east Africa, and six in western Asia. The distribution of the Asiatic sites is especially to be noted. Four lie along the lands flanking the desert which Prof. Breasted has happily termed "the Fertile Crescent"—at Megiddo, Calneh, Khorsabad and Tell Asmar—and two are in the mountain zone which backs the "Crescent", one at the western extremity—Arpachiyah in Anatolia, and the other at Persepolis at its eastern end.

We cannot follow in all its detail the focusing of research which is implied in the choice of these sites; but one or two salient features call for reference. Megiddo, the gate of entry to Palestine from the north, and the battle ground of the nations, has revealed for the first time the general plan of a considerable Palestinian city; a Canaanitish city also is being unearthed, beneath which, it is anticipated, may lie evidence of early prehistoric man. This site has provided material for a corpus of Palestinian pottery with characteristic 'fossils'. At Calneh, west of Aleppo in Syria, streams of influences from the Mediterranean and western Asia come together; with them is evidence of the incursions of the Hittites into "the Fertile Crescent" to seize Egyptian conquests in this north-eastern corner of the Mediterranean. At Khorsabad and Tell Asmar, north-east of Babylon, the Sargonid period—though not exclusively—has been the centre of interest, and under Dr. H. Frankfort's exploration, the latter site has yielded new material for an understanding of Sargonid culture and for dating purposes in the third millennium B.C. as the first fruits of a campaign planned to last ten years. In the Highland zone, an area of characteristic culture and ethnologically important as a source of Armenoid broad-heads, the origins of the Hittite empire and culture are being probed at Alishar.

What, however, may prove the greatest undertaking of all has been initiated at Persepolis, where an almost unknown sequence of cultures extends from the neolithic age to the time of Cyrus and beyond. The work of the expedition varies from the examination of a prehistoric village which has yielded a previously unrecognised type of painted pottery, earlier than any previously known, including Susa I, to the restoration of the Achæmenid palace, the greatest monument of early Persian art.

In Egypt the undertakings of the Institute are no less crucial. The problems of man's earliest phases of cultural development are being explored in a geological and archæological survey, of which the first stage has been initiated by Dr. K. S. Sandford in the Nile Valley. It will be transferred at a later date to the Euphrates–Tigris area. For each later phase of special significance in Egypt, there is an appropriate centre of activity: the beginnings of economic, social and moral development in the Old Kingdom tombs of Saqqarah; the examination and record of the 'Coffin texts', initiated by Prof. Alan Gardiner, for the growth of ideas relating to the life after death in the Feudal Age under the Middle Kingdom, when the national idea was coming into full flower; the architectural and epigraphic surveys of the great temples of the Empire at Medinet Habu; and the study of Egyptian pictorial art as exemplified in the wall paintings of Abydos (again a work initiated by Prof. Alan Gardiner), where the Institute has worked in conjunction with the Egypt Exploration Society.

The Institute's field activities extend from the palæolithic age down to Byzantine and Moslem times, a remarkable range to be covered by a single organisation. Yet nothing has been said of the great tasks necessary to be carried out at home to keep abreast with progress in the field. What is at present the greatest undertaking in this department, the Assyrian dictionary, must be served with a passing reference. Its compilation began in 1921; it will include 20,000 figures, and five years more must elapse before even the filing is completed.

If archæological studies owe a debt of gratitude to John D. Rockefeller, Jr. for the financial support of several of the Institute's 'undertakings' which made them possible, no less credit is due to Prof. Breasted for the enthusiasm which inspired that generosity and the devoted efficiency which has justified it.

Physiological Studies of Fungi

Researches on Fungi. By Prof. A. H. Reginald Buller. Vol. 5: *Hyphal Fusions and Protoplasmic Streaming in the Higher Fungi, together with an Account of the Production and Liberation of Spores in Sporobolomyces, Tilletia and Sphærobolus.* Pp. xiii+416. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 25*s.* net.

PROF. BULLER in the latest volume of his "Researches on Fungi" has broken away somewhat from the main theme of his previous four volumes in that he is not here concerned mainly with the structure of the hymenium and the production and liberation of basidiospores. The method of treatment is the same, however, and there is the usual detailed description of the way in which the results were obtained, abundance of illustrations and full summary. As the secondary title indicates, the volume is divided into two parts.

The first chapter deals with the formation of hyphal fusions in the mycelia of the higher fungi. Every mycologist is aware of the frequency of such fusions, and the first twenty-five pages refer to previous published work, including a useful summary of Burgeff's important researches on the parasitic Mucorineæ. As the result of his own investigations, the author holds that all hyphal fusions are essentially end to end, and he analyses the different ways in which they are brought about. The mode of formation of the important clamp connexions, present in most diploid mycelia, is fully considered. The view that these have some sexual significance is rejected—"the clamp-connexion may be regarded as a means for providing between any two adjacent cells of a diploid mycelium two septa instead of one and, therefore, two passage-ways for the streaming of the protoplasm instead of one".

The second chapter is concerned with the translocation of protoplasm. The streaming of protoplasm must have been noted by everyone who has examined a living mycelium under a microscope, and there have been several detailed studies of the phenomenon. Most of these, however, have been on members of the Phycomycetes, where there is a continuous mycelium, and little attention has been paid to how streaming could occur in septate mycelia. The presence of pores in the septa has been recorded in many fungi, and, indeed, Wahrlich in 1893 found protoplasmic connexions in every fungus he examined except *Oidium lactis*. It is surprising how this important point has been neglected except to bolster up the once popular 'Floridean ancestry' idea. Summarising previous observations, Buller says: "we may conclude that Ascomycetes, Basidiomycetes, and Fungi Imperfecti resemble Phanerogamia, Pteridophyta, Muscineæ, and multicellular Algæ in that all the living cells which make up an individual plant are connected together so as to form a single mass of protoplasm". In his own observations he found that vacuoles will pass through the pores in the septa and that the rate of flow of the protoplasm is about the same in the thin septate hyphæ of certain Ascomycetes as in the non-septate and relatively thick hyphæ of Phycomycetes; apparently the septa offer but little resistance to the flow of protoplasm from cell to cell. The general flow is in one direction only, from older hyphæ which have ceased to grow towards rapidly growing younger hyphæ.

Woronin in 1886 recorded that in *Ascobolus pulcherrimus* a few highly refractive particles could usually be seen on one or both sides of each septum, and these were more fully studied by Ternetz (1900) in *Ascophanus carneus*. They have since been recorded by several observers, sometimes being called 'metachromatic bodies'. Buller regards this designation as unsatisfactory and proposes the name 'Woronin bodies'. This seems equally unsatisfactory, as it is liable to be confused with the well-known 'Woronin's hypha', a term introduced by Füisting more than sixty years ago for a certain type of archicarp.

When a cell on one side of a septum is killed, the pore is immediately closed by a plug of coagulated protoplasm so that the escape of protoplasm is prevented. At the same time the septum is bulged outwards from the living cell by osmotic pressure.

The biological significance of septation, perforation and imperforation (Phycomycetes), and protoplasmic streaming are fully discussed.

Although it is probable that the main facts of the first part of the present volume were more or less generally known, it is certain that their significance in relation to recent advances in our knowledge of the life-histories of the higher fungi was little realised.

Part two of the volume is concerned with *Sporobolomyces*, *Tilletia Triticii* and the *Sphærobolus* gun and its range.

Sporobolomyces was founded by Kluyver and van Niel in 1924 for certain reddish yeasts which

discharge spores into the air "by means of a peculiar mechanism". First observed by Lasché in 1792, they had been known since 1894 to produce a mirror-picture formation on the lid of an inverted Petri-dish culture. Kluyver and van Niel showed that the yeast cell forms a spore on a pedicel and that discharge is brought about by a drop excretion mechanism similar to that found in Hymenomycetes and rusts. They regarded *Sporobolomyces* as a Basidiomycete. As was to be expected, this idea has given rise to some controversy. In 1930, Derx proposed the family Sporobolomycetes to include *Sporobolomyces* and a second genus differing in colour and shape of spores which he appropriately named *Bullera*. A detailed account of *S. roseus* is given by Buller. He confirms Kluyver and van Niel's general account but states that two, three or possibly four spores are often produced in succession from the same sterigma. Guilliermond's statement that the cells are uninucleate at all stages and do not show karyogamy is also confirmed.

The Sporobolomycetes are of great systematic interest. Are they Basidiomycetes ? Buller holds that "(*a*) the peculiar shape of the conidium which is due to its possessing an excretory hilum that is developed on one side of the top of the sterigma, (*b*) the presence of a sterigma of typical conical shape beneath each conidium, and (*c*) the discharge of the conidium by the drop excretion-mechanism . . . clearly indicates that *Sporobolomyces* belongs to the Basidiomycetes".

It is not possible to enter into the many points that have to be considered in coming to a conclusion. The yeast cell is certainly not a basidium, and the repeated production of spores from the sterigma is anomalous for a Basidiomycete. Buller's point of view is perhaps best expressed in a footnote on secondary spores. "If one assumes, as Lohwag evidently does, that only a basidium can produce a basidiospore, then, of course, it is impossible to regard a secondary spore as a basidiospore without confusion in ideas and terminology ; but, if one does not make that assumption, then one has no difficulty in regarding a secondary spore, which exactly resembles in outer form, nuclear content, and mode of discharge the basidiospore from which it has been formed, as exactly what it looks like, namely, a basidiospore." It must be remembered, however, that the basidium of a Gasteromycete such as *Sphærobolus* has no sterigmata and consequently no drop-excretion mechanism !

In my opinion the systematic position of *Sporobolomyces* and *Bullera* is still doubtful. It is possible that we may not yet have the whole story of the life-cycle, but whether or no, all suggestions about the possible origin of the group are at present pure guess work.

The main points of the chapter on *Tilletia Tritici* were given in a letter to NATURE of December 26, 1925, pp. 934–5. Here the secretion-drop method of discharge leads to an interpretation of the secondary conidium of Brefeld as a special type of primary sterigma borne by the basidium-body (promycelium). This interpretation will doubtless be questioned by those regarding the promycelium as a basidium. It seems, however, that here we are safer in applying the criterion of spore formation and discharge than in *Sporobolomyces*. Most mycologists regard the Ustilaginales as Basidiomycetes, and the question at issue is merely what are to be regarded as basidiospores. Are the primary conidia the basidiospores, and the secondary conidia what are elsewhere called secondary spores, or are the primary conidia to be interpreted as primary sterigmata as Buller holds, or have we an entirely new interpolated structure ? If we have a new structure, why give it an old name ?

The volume ends with a description of the *Sphærobolus* 'gun'. The glebal mass of *S. stellatus* is a solid spherical body with a diameter of 1–1·25 mm. The minimum range to which this was shot in Buller's experiments was 7 ft. 8·5 in. vertically and about 15 ft. horizontally when inclined at an angle of 45°—a remarkable range when the size of fruit-body and glebal mass are considered. The kinetics of the propulsion are fully worked out.

Prof. Buller's method of presenting his results is not one that appeals to everyone, but it is certain that the facts recorded in the volume under review will have considerable influence on mycological ideas. J. RAMSBOTTOM.

The Way and the Truth

The Universe of our Experience. By Dr. L. M. Parsons. Pp. 186. (London : Williams and Norgate, Ltd., 1933.) 7*s.* 6*d.* net.

A New Fundamentalism. By James Maxwell Henry. Pp. 226. (London : Macmillan and Co., Ltd., 1934.) 7*s.* 6*d.* net.

THESE two books are symptomatic of the universally felt need of a new outlook in philosophy which will enable the recent startling

changes in science to be regarded as natural developments instead of a lapse into insanity. Neither would profess to meet the need fully, but the authors of both address themselves to a larger task than the mere description of the present position. Each author makes an attempt at a summing-up, Dr. Parsons's conclusion being that a single comprehensive philosophy is scarcely possible, while Mr. Henry offers us a unifying hypothesis which, whether possible or not, is scarcely credible.

(1) Dr. Parsons's book is intended to present to the plain man "a connected series of universe pictures . . . sketched from different positions", its justification being that "no one branch of knowledge can lead us to a sound conception of the universe or provide us with that encouraging outlook so essential to human progress". The book may be thoroughly recommended to those who, like the author, seek encouragement. It is well written, bears evidence of a wide expanse of reading, and contains many suggestive ideas which the reader capable of thinking for himself may develop with profit. Physics, biology, psychology, philosophy and the "higher realm of personality" provide in turn the points of view from which the sketches are made; and prominence is given to the most recently discovered elements in the various scenes.

It is impossible not to recognise and admire the author's sincerity, but it is necessary to say that those who seek Truth though the heavens fall will not find here the impartiality they require. The book is essentially propagandist, and though it cannot be said that this is disguised, we feel that it might with advantage have been made to appear as clearly in the earlier as in the later pages; that, for example, the proposed search for a conception of the universe which will be "satisfactory" (an "unsatisfactory" word which occurs far too often in the first few pages) might have been more definitely described as one which will satisfy our desire for comfort and not necessarily for truth. However strongly one may agree with the author's ultimate aim, it is hard to avoid the feeling that the best methods have not been adopted. In matters on which men of science of the highest repute are honestly at variance, it is distinctly unpleasant to find one set of ideas described as entirely reasonable and the other as "unwarrantable" or "a crowning impertinence". The assumption underlying the book is best expressed on the last page, where it is stated that a man "can accept materialistic realism with its depressing implications and then assume an attitude of contemptuous defiance towards an apparently hostile universe; or he can accept some form of idealism which recognises mind and spirit as fundamental; in which case he will regard himself as a humble but vital unit performing an allotted function in the development of a holistic universe psychically activated. Being the captain of his soul he can make his choice". This reads strangely to those who feel that the choice is made for them by the entirely involuntary response of their reason to the available evidence, and we doubt whether Dr. Parsons's converts will belong to what he would regard as the highest type. He is capable of better work than this.

(2) Mr. Henry starts from a diametrically opposite position. To him "Truth is higher than goodness or beauty". "The deadly materialistic fog of Victorian science," says Dr. Parsons, "enveloped the world of thought . . . But now, with the great advances of scientific knowledge, the fog has lifted . . . The light of spiritual life is brightening once again." In Mr. Henry's view, however, "it is just as hard for us to rid our minds of the scientific fog of the present century as it was for the Victorians to rid their minds of the religious fog of the nineteenth". (It is interesting to note in passing how easily facts can be distorted by perfectly honest persons. In the Victorian age taken as a whole, was science felt to be an incubus on religious aspiration, or was religion regarded as a drag on the progress of science? This is a question of fact, not of opinion, and if both states of mind existed in comparable intensity, it is unjust to characterise the age, as both our authors do, by one of them alone. There is always the possibility, too, that the Victorians were not so fogbound after all.)

Mr. Henry agrees with Dr. Parsons in electing to survey broadly the whole field of thought and feeling instead of examining minutely a restricted part, but he gives us a very different picture. To him, everything points to the earthly existence in the past of a Golden Age when beings lived who knew neither sin nor death, whose minds were a hundred per cent conscious, and whose intelligence directed their own evolution. An unexplained 'Fall' occurred and then evolution ceased, but the author believes (like Shelley, though on very different grounds) that somehow "more than the former glory will be restored". Readers of NATURE will probably agree in holding that

intellectual conclusions are of value only when the data leading to them have been carefully examined and authenticated. Mr. Henry, however, has made it his aim "to regard every fancy which human beings have entertained as entitled to serious consideration"; and by this he does not mean consideration by psychologists as throwing light on the nature of mind, but consideration as evidence of objective fact, so that, for example, the existence of legends in which animals talk is evidence that in the Golden Age they, like men, spoke rationally.

Feeling ourselves absolved, therefore, from treating its conclusions seriously, we may with an easy conscience recommend the book warmly as a stimulant to thought on account of the many suggestive ideas which it adumbrates. It is written in an epigrammatic, semi-Emersonian style, rising at times to brilliance, which is excellent for sowing the seeds of thought but ill-fitted to display the fruits. Mr. Henry is like a man who discerns many attractive avenues into the unknown, but instead of treading any of them, guesses where they will lead. We have no use for his guesses, but we thank him for showing the ways. HERBERT DINGLE.

Science and Society

Scientific Research and Social Needs. By Julian Huxley. With an Introductory Chapter by Sir William Bragg, and Discussions with Prof. H. Levy, Sir Thomas D. Barlow and Prof. P. M. S. Blackett. (The Library of Science and Culture.) Pp. xvi+287+40 plates. (London: Watts and Co., 1934.) 7*s*. 6*d*. net.

IN this book, Prof. Julian Huxley has given a connected picture of 'British science', with particular reference to its relation to social needs, as the outcome of a broad survey of the whole field, undertaken by him at the suggestion of the British Broadcasting Corporation. The basis of the book is furnished by twelve talks and discussions that were broadcast. Here they have been considerably revised and amplified to fit them for publication in book form. The result is a volume of outstanding interest, fascination and usefulness.

In his preface the author says: "I became more than ever impressed with the fact that both our existing structure of civilization and our hope of progress are based on science, and that the lack of appreciation and understanding of science among business men, financiers, educational authorities, politicians, and administrators was a serious feature in our present situation." He adds: "Almost equally serious, however, is the absence of a broad scientific outlook on life, too often to be noted in the scientific specialist as well as in the layman." The most important lesson he learned from his tour was the realisation of the little extent to which the psychological and social sciences find any public support and practical application, as compared with the physico-chemical side of science and, to a less degree, with the biological sciences. His main plea is the need not only for scientific research in the narrow specialist sense, but also for the scientific spirit and method in careful planning.

Sir William Bragg, in an interesting introductory chapter, prepares the way for Prof. Huxley, by taking the reader with him on an imaginary journey round the little corridor outside the lecture theatre of the Royal Institution, where there are exhibited the pieces of apparatus which have been used by great experimenters of the last hundred years, particularly by those who have worked in the Institution. Taking these exhibits as his texts, Sir William Bragg reviews rapidly some of the salient features of the work of Count Rumford, of Sir Humphry Davy, of Faraday, of Tyndall, of Lord Rayleigh, and of Dewar, and sketches briefly, with the lucid simplicity characteristic of his writing, the far-reaching industrial and social developments that have sprung from the work of these pioneers; and the stage is set for Prof. Huxley.

In the twelve chapters that follow, the author ranges over a vast field, making a broad survey of the work and influence of science in regard to such matters as food, building, clothing, health, communications, industry, war and international needs. There is a chapter on "Man and Society" and one on "Pure Science", and the final chapter consists of a "Summing Up", in which the author discusses with Prof. H. Levy the main lessons to be learnt from what is rightly claimed, in a foreword, to be "one of the first surveys of science in relation to many aspects of social needs".

Let it be said at once that the book is as fascinating to read as an exciting novel. Thanks to the author's lucid exposition and smooth literary style, it can be read with effortless comprehension by the layman, even with his feet on the mantelpiece. It may be that the broadcast form in which the substance of the book was first delivered has helped to give it, as a whole, the conversational

ease of an intelligent and earnest talk over a pipe. But the concrete facts—crowds of them—and the close argument are there all the same and all the time. The present reviewer prefers those chapters in which Prof. Huxley alone speaks. The discussions with Prof. Levy, Sir Thomas Barlow and Prof. P. M. S. Blackett (especially that with Prof. Blackett) have much interest, but it is doubtful whether there is anything gained, either in clearness or in liveliness, by this resort to the Socratic method of exposition. It may tickle the ears of the wireless listener to hear the great and eminent call each other by their surnames, but, when it comes to reading a book, the flow of the argument is apt to be a little inconsequent in this highly intellectual 'backchat' (if one dare use such a phrase in such a connexion).

It is impossible within the limits of a short review to give an adequate idea of the wealth of illustration employed by Prof. Huxley to show what science has done and is doing in diverse fields. The facts lose nothing in their telling, and the scientific specialist, as well as the layman, will learn much that will be news to him. The book is, however, much more than an able marshalling of facts inherently interesting as to the part being played by science in our social and industrial life. It has all the qualities of an intellectual tonic in that it stimulates thought beyond its own range and at times almost makes one jump out of one's chair to do something. As the author shows, the work that science has done, great as it is, is but little in comparison with what it could do and might do if it were given full scope. To take one example of his suggestiveness, here is a passage from the chapter on "Man and Society": "We have got a great deal of control—quite enough to get on with for the time being—over lifeless nature: we have practically no control over human nature, and over the monsters we have unconsciously created, or at least allowed to grow up unchecked, in the shape of economic systems, unintelligent moralities, nationalist sovereign states, mass ignorance and mass hysteria."

It is to be hoped this book will be widely read, for every one of its readers will be helped to get a better perspective of what science has done, is doing and may yet do for life as a whole, in all its varied manifestations. As the author says in concluding his chapter on "Science and International Needs": ". . . science *is* influencing the world structure. Its applications are making frontiers look ridiculous, and war ever more and more appalling. Its findings and its inevitably international outlook are gradually penetrating general consciousness and showing up the stupidities of nationalist restrictions and rivalries. Science, as much as any other force, is making for the breakdown of the system which has given it birth, and in whose bounds it is now confined and cramped. Though for the time being it may be exploited for sectional ends, and may actually intensify present rivalries, in the long run it is hard to see how each new advance in science can help preparing the way, however deviously, and through however much of preliminary chaos, for the world-state".

Finally a tribute should be paid to the persuasive and reasonable tone in which the whole book is written. It does not reject Matthew Arnold's plea for "sweetness and light".

J. W. W.

Short Reviews

Theorie der Elektrizität. Von Prof. R. Becker. Neubearbeitung des Werkes von M. Abraham. Band 1: *Einführung in die Maxwellsche Theorie der Elektrizität, mit einem Einleitenden Abschnitte über das Rechnen mit Vektorgrössen in der Physik.* Neunte Auflage. Pp. vii+261. 14.50 gold marks. Band 2: *Elektronentheorie.* Sechste vollständig neubearbeitete Auflage des Werkes von M. Abraham. Pp. vii+400. 17 gold marks. (Leipzig und Berlin: B. G. Teubner, 1932–1933.)

THESE two volumes represent together a new edition of the now familiar "Theorie der Elektrizität" of Abraham. The first volume maintains more or less the old form and contains a generally well-balanced account of classical electric theory in its broader aspects, emphasis being laid on the mathematical formulation of the leading physical principles rather than on their detailed application in special cases. It is, however, disappointing to find the author still persisting with the usual confused treatment of magnetic energy and also with an elaboration of Helmholtz's treatment of dielectric stresses, which was shown by Larmor some forty years ago to be both mathematically inconsistent and physically impossible.

The second volume has been entirely re-modelled from the original form due to Abraham. A number of sections of the original discussion which have proved to be non-essential have been omitted and the opportunity taken to discuss the more recent developments of electron theory—bringing it to

the borders of quantum theory—and also the more generalised aspects of relativity. In these new developments there is no attempt at exhaustiveness, the object being merely to show as clearly as possible the relation between the older ideas and results of the electron theory and the form which these ideas take in the more modern aspects of the subject.

Generally, one can but compliment Prof. Becker on having retained the spirit of the older work in a book, written more in conformity with modern needs, and which can therefore be commended to all students commencing a study of these fascinating subjects.

Romping through Physics. By Otto Willi Gail. Translated from the German by H. Stafford Hatfield. Pp. 64. (London: George Routledge and Sons, Ltd., 1933.) 4*s.* 6*d.* net.

THIS little work is not, as one might suppose from its title, an ultra-humanised physics textbook, but is an altogether remarkable and diverting account, written in colloquial style, of the laws of Nature as applied to ordinary and extraordinary sets of circumstances and apparent anomalies. There are no chapters; after a few pages on heat the book goes on to mechanics: weight, centrifugal force, lifts, gravity. One discovers why a sunken ship must always reach the bottom of the sea irrespective of the depth, and that wood must float in air at the bottom of a mine 30 miles deep. Finally, the problem of a man falling down a shaft bored through the centre of the earth is elucidated, and the amazing consequences of a sixteen-fold speeding up of the rotation of the earth on its axis are described. The pages are enriched with no less than 103 semi-humorous drawings in colour, and these, together with the general style of the production, make the book something of an artistic achievement.

By judicious use of some of the ideas an enterprising teacher of mechanics might contrive to enliven and stimulate considerably a subject which more often than not is rendered dull and uninteresting.

North Sea Monster. By D. A. Spencer and W. Randerson. Pp. 246. (London: Houghton and Scott-Snell, 1934.) 7*s.* 6*d.* net.

THE dust-cover of this story of adventure, in which "every incident . . . is scientifically possible" (although usually statistically improbable), suggests that when two men of science, one of whom is a humorist and the other a student of international affairs and a world-wide traveller, collaborate to write a novel, it is to be expected that the result will be unusual. That many authors of 'thrillers' lack humour, appreciation of international affairs, and the most elementary knowledge of science is doubtless true and regrettable; that it is possible to avoid the usual defects of such a novel and produce a readable and, in fact, properly exciting, story at the same time has now been demonstrated. The authors do not pretend to make any contribution to serious scientific literature; they are frankly disposed to entertain, and possibly to show that scientific people laugh and shiver with the rest. Nevertheless, they make use of their opportunities to comment on the folly of war and on the absurdities of a situation in which those who seek peace and ensue it need to be heavily armed for their quest. Where argument and example fail, ridicule—competently enveloped in a garb of fiction—may play a useful part.

The General Principles of Quantum Theory. By Prof. G. Temple. (Methuen's Monographs on Physical Subjects.) Pp. viii+120. (London: Methuen and Co., Ltd., 1934.) 3*s.* net.

THIS monograph gives an introductory account of the general principles which form the physical basis of the quantum theory. The author states that the theory is considered as a branch of physics and not as a branch of mathematics and that the exposition is restricted to a discussion of general principles and does not attempt their detailed application to the wide domain of atomic physics.

The book is, however, wholly mathematical, and could be of service only to a reader having much more than an elementary mathematical equipment. The five chapters deal with the theory of linear operators, the laws of measurement in atomic physics, the exchange relations and the equations of motion, the spin operators, and composite systems. The framework of the modern quantum theory is thus set up in the most concise possible form, as concerning operators and matrices. Wave mechanics, being treated in a separate volume of the series, is excluded except for consideration as that form of the general method appropriate to variables with continuous spectra. N. M. B.

Free Radicals: a General Discussion held by the Faraday Society, September 1933. Pp. iv+248+7 plates. (London: Faraday Society, 1934.) 12*s.* 6*d.*

THE general discussion on free radicals organised by the Faraday Society at Cambridge in September last has now been published in book form (see also NATURE, 132, 665, Oct. 28, 1933). The subject was discussed under the general headings of free radicals of relatively long life and of short life from both the physical and chemical aspects. A number of distinguished foreigners were present so that the discussion was fully representative of present knowledge of the subject: it is published with commendable promptness. An increasing amount of attention is being given to the ionic theory of organic reactions; the discovery of free radicals of the triphenyl methyl type in 1900 which can be prepared by ordinary chemical means gave the first impetus to the new conceptions; to-day Paneth has isolated methyl and ethyl radicles with a life of only about 0·006 sec. which yet makes it possible to use them in synthetic work; free radicles of short life are often postulated as intermediate products of chemical change.

William Hyde Wollaston, F.R.S. (1766-1828)

UNVEILING OF MEMORIAL PLAQUE

THE great variety of interest and versatility of achievement of the scientific men of the early nineteenth century has often been a matter of comment. The name of William Hyde Wollaston stands among the highest of these workers, and that time has not detracted from his reputation is attested by the honour done to his memory in the past few days. As a result of the co-operation of no fewer than six societies—the Royal Society, Geological Society, Royal Astronomical Society, Chemical Society, Physical Society and Mineralogical Society—a memorial plaque was erected on 14 Buckingham Street, W.1, a house occupied by Wollaston from 1801 until 1825 ; and was unveiled on July 4 by Sir Frederick Gowland Hopkins, president of the Royal Society. The scheme was initiated by the Geological Society, and, at the ceremony, the Royal Society, Royal Astronomical Society, Chemical Society, and the Mineralogical Society, were represented by their respective presidents. Amongst those who attended were several members of the Wollaston family.

In the course of an address delivered before unveiling the plaque, Sir Frederick Gowland Hopkins said : "Only a few names in the history of science stand out so prominently as to be heard in common parlance . . . it is our hope that in placing Wollaston's name on a house in which he dwelt, we may tempt many more of his countrymen to seek acquaintance with the life's work of a truly great Englishman". Wollaston, after passing through Charterhouse and Gonville and Caius, a college of which he became a fellow, commenced medical practice, but he relinquished it in 1801, as he found the professional duties of medicine wholly uncongenial. "We cannot indeed understand his temperament aright," said Sir Frederick, "unless we fully realise how acutely the anxieties involved in medical practice affected him." He quoted a remark of Wollaston to his friend Hasted in this connexion concerning "mental flagellation termed anxiety". "The anxiety was for his patients who looked to his skill for aid. When he felt that skill to be unequal to their needs he suffered greatly in spirit." Wollaston retained his interest in medicine, however, and the Royal College of Physicians in recognition of his services made him an elect.

"Before he gave up medical practice," continued Sir Frederick, "Wollaston had already published work of general importance, but when first freed from its anxieties he determined to devote himself more particularly to chemical studies." Such, however, was the catholicity of his interests that his publications came to deal, not with chemistry alone, but with a multitude of subjects. "Of some sixty papers mostly published in the *Philosophical Transactions of the Royal Society*, there is scarcely one that lacks real distinction and importance. Their author was an admirable exponent, and his publications are models of what scientific publications should be."

Among his earlier successes, Wollaston made a great advance on the then existing methods of rendering platinum malleable, and, in the course of his experiments, he discovered palladium and rhodium. A paper in 1808 on super-acid and sub-acid salts did much to encourage belief in the law of multiple proportions, and the acceptance of Dalton's atomic theory. As a pioneer in biochemistry he recognised the need for chemical studies in pathology, and discovered cystine, a substance very prominent in biochemical research to-day.

Wollaston applied his chemical knowledge to mineralogy, analysing many minerals and other geological specimens. For crystallography he invented the reflecting goniometer. In the general field of optics he performed pioneer work in spectroscopy, and his total reflection refractometer was employed for his classical experiments on Iceland spar. He is remembered by the Wollaston prism, and the camera lucida ; and it is interesting to note that Fox Talbot's experiments that led to the production of photographic impressions on paper "were the outcome of an idea which came to him when sketching the scenery of Lake Como with the aid of Wollaston's Camera Lucida".

Wollaston also made important contributions to early experimental and theoretical work on electricity, and, from a consideration of contemporary experiments in 1821, "he felt that a conductor carrying an electric current should revolve on its axis under certain applied magnetic conditions. He failed in achieving such a result. But shortly afterwards, Faraday succeeded in obtaining the rotation of a current-carrying conductor around a magnet, and vice versa. A charge of plagiarism was laid by Wollaston's friends. Faraday succeeded in establishing his innocence with Wollaston, who exerted himself later on when Faraday was up for election to the Royal Society to overcome the opposition still existing—his name is the first on Faraday's certificate of candidature".

In the field of astronomy Wollaston's contributions were also noteworthy. "A report of the Council of the Astronomical Society published in 1829 summarising Wollaston's service to the science contained the following statement : 'Among the most remarkable of his astronomical papers, however, is that on the finite extent of the atmosphere, which affords a striking instance of the advantages that may accrue to science by the union of remote branches of knowledge in the same mind.' "

Other examples of this "union of remote branches of knowledge in the same mind" are Wollaston's invention of the cryophorus, his studies of 'fairy rings' in pastures, his work on

sounds inaudible by certain ears, and physiological investigations, such as the duration of muscular motion and sea-sickness, discussed in his Croonian lecture, all of which further attest his wide interests. His skill as a technician was very great and is frequently commented upon by his contemporaries.

Another phase of Wollaston's activities is reflected in his twelve years' secretaryship of the Royal Society, of which he was later interim president, in 1820. He received many honours, an outstanding one being his election as one of the eight foreign associates of the Paris Academy of Sciences. He was a benefactor to the Geological Society and for more than a hundred years that Society has commemorated him by the annual award of the medal which bears his name, the highest which it can bestow.

Wollaston had many close friends among scientific workers at home and abroad and not a few have recorded their deep admiration for him both as an investigator and as a man. "Berzelius for one was an enthusiastic admirer. In some of his letters indeed the great Swede writes of Wollaston in almost extravagant terms of praise. Faraday in 1821 said that 'His character and talents have raised him to be a patron and protector of science. All men look to his opinion and judgment with respect'." "Some of his more intimate friends have left eloquent testimony to his lovable qualities as a man"; "of the great pleasure he always derived from the company of children and young people"; of his modesty "but also upon the indignation he would display when faced with the slightest deviation from honesty and truth, or any departure from justice". Miss Edgeworth sums up an estimate of him in the words "He confirms . . . the opinion I have always held, that great talents are always connected with warm affections—with what is commonly called *heart*".

Sir Frederick Gowland Hopkins acknowledged his indebtedness for information on aspects of Wollaston's scientific work to Mr. L. F. Gilbert, of University College, London, who is engaged in compiling a biography of Wollaston and suggested, in the first instance, the erection of the memorial.

W. T. GORDON.

Yale North India Expedition

By G. E. HUTCHINSON, Osborn Zoological Laboratory, Yale University

ALL the members of the expedition of the Yale North India Expedition 1932–33, under the leadership of Dr. H. de Terra, having returned to Yale University more than a year ago, it is now possible to give a brief preliminary account of some of the results of the field work achieved.

In our geographical studies we were fortunate in securing the services of the distinguished Indian topographer, Khan Sahib Afraz Cul Khan, who surveyed 4,600 square miles of imperfectly mapped country on the western borders of Tibet. Dr. de Terra, using this new map in conjunction with his geological studies, has been able to recognise the eastern continuation of the Karakorum on to the Tibetan plateau[1]. The orographic axis of the range undergoes a bend from north-west–south-east to west–east, so that the Karakorum clearly fails to make its supposed connexion with the Transhimalaya. The re-entrant, clearly marked in all the component ranges of the Karakorum, is represented throughout the whole of the mountain belt between the Ganges and Central Asia, and corresponds to that of the Gondwanaland mass.

Wadia had previously demonstrated the overthrusting of the southern Himalaya towards Gondwanaland, and this has now been confirmed on a larger scale, embracing the north and central portions of the range. The main geotectonic structure of the entire mountain belt is seen to consist of the southward shifting of successive belts of folding towards India, beginning in the Middle Cretaceous and lasting until to-day. As in the case of the Alps, the overthrusts have moved mainly across 'flysch' and 'molasse' rocks and in many places are connected with basis volcanics in part of submarine origin. In the late Pleistocene, the Pir Panjal Range was added to the Tertiary mountain belt, and various piedmont levels on the Tibetan plateau indicate that uplifts have been of recurrent occurrence throughout the Pleistocene.

Dainelli's idea of four Himalayan glaciations in the Quaternary has in the main been confirmed, but the detailed study of interglacial deposits leads to somewhat different results from those of earlier workers. In relation to the studies carried out on the Pleistocene deposits of the region, our discoveries of human artefacts, though few and fragmentary, acquire a special significance. The most interesting find was a flake of Levallois type discovered in a lake deposit near Srinagar, Kashmir. Another important site, also yielding specimens representing an early palæolithic flake culture, was discovered near Chitta in the Salt Range. A detailed report on this material by Mr. and Mrs. C. Hawkes is now in the press[2].

Mr. G. E. Lewis, palæontologist of the expedition, made a very large collection of Tertiary mammals, principally in the Salt Range and Simla Hill States. Among the rich material of Primates, one form, *Ramapithecus brevirostris*, Lewis, described in a recent preliminary communication[3], deserves special mention. This Upper Siwalik form, represented by a right maxilla and premaxilla, appears in its parabolic dental arcade, small transverse canine alveolus, absence of diastemata, small incisors, high palate and slight prognathism, to approach more closely to the Hominidæ than any previously discovered Tertiary

ape. The presence of such a form in these beds on one hand, and of early palæolithic cultures in the North Indian Pleistocene on the other, inspires the not too remote hope that very primitive hominids may one day be found in this region.

A preliminary note on some of my limnological work has already appeared in NATURE[4]. It is as yet scarcely possible to evaluate the zoogeographical significance of the large collection of fishes and invertebrates brought back. Two points may, however, be briefly noticed.

On the basis of his geomorphological studies, Dr. de Terra has reconstructed[1] the Tertiary drainage pattern of the western part of the Tibetan plateau. A number of rivers ran from west to east, one of them occupying the present valley of the Upper Indus. It is difficult to resist the conclusion that a similar pattern extended farther north, the Tarim basin draining into the Hwang-ho. If this hypothesis be accepted, it is possible to give a rational explanation of the distribution of the most characteristic group of Central Asiatic fishes, the Schizothoracinæ. At present this sub-family occurs in at least twelve major river systems and numerous small closed basins. My field studies appear to indicate that the most primitive genus *Schizothorax* is most abundant in relatively quiet water, while the species found in the most rapid streams belong to the most specialised genera. This is to be expected if we suppose that the sub-family was distributed as the Tertiary drainage pattern suggests, from a centre in the present Karakorum, then a region of comparatively late mature relief, the truly torrenticolous genera such as *Dyptichus* not evolving until the progressive uplifts had provided a system of suitable habitats for such forms. Further problems of distribution are raised by these and other fish, but it would be out of place to discuss them until the entire collection has been studied by Dr. S. L. Hora.

A second zoogeographical result emerges from a study of the insects of high altitudes. In examining the collection of terrestrial Heteroptera, I have been much impressed by the high proportion of endemic forms; at least half the species are peculiar to the higher parts of the Himalaya and western Tibet. This contrasts strikingly with the situation presented by the Pamirs[5], where the fauna though richer is much less peculiar. In spite of the intense Quaternary glaciation of the better-known parts of western Tibet, it seems impossible to avoid the conclusion that a large part of the Tibetan Plateau was unglaciated, forming, as Meinertzhagen[6] has emphasised, a biological island in which species and even genera were differentiated, and from which the glaciated regions were re-colonised.

[1] *Geog. Rev.*, **24**, 12; 1934.
[2] *Mem. Connecticut Acad. Art. Sci.*, **8**, 1.
[3] *Amer. J. Sci.*, **27**, 161; 1934.
[4] NATURE, **132**, 136, July 22, 1933.
[5] Kiritschenko, "Abh. der Pamir-Exped. 1920", **8**, 77; 1931.
[6] *Geog. J.*, **70**, 129; 1927.

The Mersey Road Tunnel

THE tunnel constructed under the Mersey for vehicular traffic between Liverpool and Birkenhead, which was opened by H.M. the King on July 18, is a great engineering construction possessing many interesting features. It is the largest sub-aqueous tunnel yet constructed, its ventilation installation is on an elaborate scale and the architectural treatment of its entrances and buildings have received as much consideration as the construction of the tunnel itself. The consulting engineer for the scheme is Sir Basil Mott, Bt., with whom has been associated Mr. J. A. Brodie, for many years the city engineer of Liverpool, while Mr. H. J. Rowse is the architect of the ventilation buildings. Others who have been called in to advise on various matters include Prof. P. G. H. Boswell, Prof. Douglas Hay and Prof. J. S. Haldane.

A railway tunnel beneath the Mersey has been in use since the 'eighties of last century, but the ever-increasing stream of passengers and vehicles crossing the river by the ferries has long shown the need for further facilities. In 1925 the local authorities obtained from Parliament the Mersey Tunnel Act, and under this was set up the statutory body, the Mersey Tunnel Joint Committee, the controlling authority for the construction of the tunnel. The general plan of the project includes a main tunnel for four lines of traffic from Old Haymarket, Liverpool, to Chester Street, Birkenhead, 3,751 yards long, with two branch tunnels for two lines of traffic, one on either side of the river, bringing the total length of roadway up to 5,064 yards. It is estimated that the tunnel will have a capacity of 4,150 cars per hour moving at 20 m.p.h., the time taken for a vehicle to pass along the tunnel being 6½ minutes. Side-walks are provided on both sides of the roadways for the staff, but in normal circumstances the tunnel will not be used by pedestrians.

The portion of the tunnel of greatest interest is that beneath the river bed. Here the bottom of the tunnel is 170 ft. below high water, while above the top is an average thickness of 30–35 ft. of rock, gravel and clay. The rock is red triassic sandstone. Circular in section, this portion of the tunnel has external and internal diameters of 46¼ ft. and 44 ft. respectively. It is thus the largest sub-aqueous tunnel in the world, the Rotherhithe Tunnel, London, having a diameter of 30 ft. and the Holland Vehicular Tunnels, New York, a diameter of 29½ ft.

Begun in 1925, two pilot headings were first driven from each of the two shafts sunk on each side of the river and the workings met almost exactly in the middle of the river bed on April 3, 1928. The divergence of line, length and level was very slight. These pilot headings were then

progressively enlarged, and stage by stage the tunnel was lined with cast-iron segments each weighing about a ton, placed in position by a special erecting machine. All segments were machined at the joints and watertightness was ensured by the use of lead caulking. The 4½ in. space between the back of the circular lining and the rock was then filled in with stone and a grout of cement and sand. Later on, the internal spaces of the segment were filled with concrete and finally finished with cream-coloured gypsum plaster sprayed with a transparent polish.

The roadway of reinforced concrete is built on a line a little below the horizontal diameter of the tunnel and is supported on two longitudinal reinforced concrete walls 21 ft. apart. These walls divide the lower portion of the tunnel into three sections, the centre one of which may perhaps at some future time be used for single-deck tramcars, and two side passages, approximately triangular in section, which will be used for the supply of fresh air. The air will find its way into the tunnel through longitudinal ducts on either side of the roadway at the level of the kerb. Provision is also made for electric cables, water mains and drainage pipes.

The ventilation system was designed after full-scale experiments on a length of 1,000 ft. of finished tunnel using full-sized fans. These experiments were supervised by physiologists and ventilation experts, and they were also directed to ascertain which system would give the best results in the event of a serious petrol fire. As a basis, a traffic flow of 3,000,000 vehicles a year was assumed, and the plant as installed will ensure that, under normal conditions, the proportion of carbon monoxide will not exceed 2½ parts in 10,000 parts of air, or 4 parts in 10,000 under extreme peak-load conditions. There are six ventilation buildings, three on each side of the river, with supply and exhaust fans, the whole plant including 30 fans with a total capacity of 10,000,000 cub. ft. of air per minute, each section of the plant being duplicated. Each ventilation building consists of a steel-framed structure with a central tower. In each case, fresh air will be drawn through intakes in the roof of the building by the supply fans and discharged into the air ducts, while the foul air will be drawn by the exhaust fans from the upper part of the tunnel and discharged up the central tower. All the fans are electrically driven and are remotely-controlled from the ventilation building at George's Dock, Liverpool, which will house the administration offices. The many other interesting features of this great undertaking include the pumping plant for dealing with water which may find its way into the tunnel, a system of lighting which does away with the necessity of cars switching on their head or side lights, fire and telephone stations and signals for instructing drivers to stop their engines. The cost of the whole scheme, including purchase of the land, has been about £7,000,000, towards which the Government made a grant of £2,500,000 from the Road Fund. Loans have been raised by the Corporations of Liverpool and Birkenhead which will be paid back out of the tolls and the rates. A fully illustrated account of this important work was given in *Engineering* of January 19, February 16 and March 16.

International Council of Scientific Unions

Meeting at Brussels

THE International Council of Scientific Unions (formerly the International Research Council) held its first triennial meeting, since its new statutes were adopted, on July 8–13 at Brussels. The general assembly of delegates met at the Palais des Académies, Brussels, and elected Dr. N. E. Nörlund, director of the Geodetic Institute, and Rector of the University of Copenhagen, president for the period 1934–37; General J. F. Bourgeois, of the Academy of Sciences, Paris, and Marchese Marconi, president of the National Research Council of Italy, were elected vice-presidents. Dr. Pelseneer and Dr. Went remain members of the executive committee, and Sir Henry Lyons the general secretary.

At this meeting for the first time, the International Unions of Astronomy, Geodesy and Geophysics, Chemistry, Scientific Radio, Physics, Geography and the Biological Sciences, attended as members of the Council, and communicated very interesting accounts of their activities in their respective scientific fields of work during the past three years.

For the first time also, addresses were given on scientific matters of general interest, and these included, on this occasion, one by Dr. D. la Cour on the International Polar Year, 1932–33, its aims, methods and some preliminary results; another by General G. Perrier, on recent international determinations of longitude; while Dr. E. P. Hubble spoke on the exploration of space, and Prof. H. R. Kruyt on electricity and hydration with colloids.

The International Committee on the Relationship between Solar and Terrestrial Phenomena was reappointed, and another on instruments and methods met to arrange its future procedure.

The following motion, put forward by the Royal Academy of Sciences, Amsterdam, was unanimously adopted by the General Assembly:

"The International Council of Scientific Unions, being aware of the fact that the present economic and political difficulties have brought humanity face to face with a number of the most complicated and dangerous problems and threaten to erect a system of barriers between various nations, expresses its deep faith that ultimately a way will be found leading towards a more harmonious economic structure, and wishes to stress the importance of maintaining by all means international co-operation in the

domain of science under whatever circumstances may present themselves.

"As laid down in its Statutes, the Council recognises the relations between pure and applied science. There is no doubt that both governments and industrial groups will in an ever increasing degree call upon scientists for elucidation of the manifold complexities and problems which human life and human relationship are presenting —problems, the most important of which perhaps are those of finding food, space in which to live and employment for the various peoples spread over the earth. If at the present moment an international organisation devoted to the solutions of these problems is still beyond our vision, and organisation constructed according to national systems must provisionally be strengthened for fear of losing hold of economic possibilities, it can be foreseen that the scientists of every country will be drawn more and more into these spheres of national organisation. The Council expresses its confidence that scientists, while giving their aid in meeting the needs of their own nations, will never lose sight of the international character of science as a whole, and will ever continue to keep in working order and to develop the connections necessary for international co-operation, even if severe shocks unhappily might come to threaten economic and political relations.

"In professing its faith in the possibility and the necessity of peace between the world's peoples, the Council points out that the "brotherhood of scientists" can be an important factor towards the establishment of a desire for mutual understanding and helpfulness in order to overcome the dangers involved in a too exclusive nationalism.

"The Council therefore, in emphasising the significance of science, both pure and applied, as a common treasure for all humanity, which can only be realised through a free-spirited co-operation of the most diverse elements, is of opinion that scientists of the whole world have a task of working for this understanding, and urges all allied organisations to give constant attention to this task."

The General Assembly accepted unanimously an invitation from the Royal Society to meet in London in 1937.

Obituary

MME. CURIE

MME. CURIE, whose death occurred on July 4 after a brief illness, held an outstanding position in science, for she had long been regarded as the foremost woman investigator of our age. Although her greatest scientific work, the discovery and isolation of radium, was done nearly thirty years ago, yet, as professor in the Sorbonne and director of the Radium Institute in Paris, Mme. Curie until the time of her death was actively engaged in researches on the physical and chemical properties of the radioactive bodies. At the same time, she was also director of a vigorous school of research which attracted investigators from many countries. During the last few years, she was engaged in preparing preparations of actinium much stronger than had previously been available, for the purpose of examining the fine structure of the α-ray groups emitted by the products of this element. With the help of her colleague, Dr. Rosenblum, and the use of the large Paris electro-magnet, many new results of importance were obtained.

Marie Sklodowska was born at Warsaw on November 7, 1867, and received her early education in that city. Interested in science, she resolved, notwithstanding financial difficulties, to go to Paris to perfect her scientific training, and took lectures and examinations in the Sorbonne. In 1895 she married Pierre Curie, a young physicist in Paris who was making those highly original and fundamental contributions to magnetism and crystallography so well known to every student to-day. The young couple joined forces in their scientific work, which was carried out initially under difficult conditions, for laboratory arrangements were poor, and both had to undertake much teaching to gain a livelihood.

The turning point of the scientific career of Mme. Curie came as a consequence of the fundamental discovery of radioactivity by Henri Becquerel in Paris in 1896. He showed that the element uranium spontaneously emitted new types of penetrating radiation which darkened a photographic plate and discharged electrified bodies. This new discovery attracted the attention of Mme. Curie and, using the electric method as a means of quantitative analysis, she showed that the radioactivity of uranium was an atomic property. She also observed that the mineral pitchblende, from which uranium was separated, showed four to five times the activity due to the uranium alone. Since the activity of uranium was due to the atoms alone, this observation could only be explained by the presence of a new element or elements in the pitchblende much more active than uranium.

Boldly relying on this hypothesis, Mme. Curie made a systematic chemical analysis of pitchblende, using the electric method as a means of qualitative and quantitative analysis of the activity of her preparations. The first active element observed by these methods had properties allied to bismuth and was called polonium after her native country. She later discovered the presence of another element, happily named radium, which was similar in chemical properties to barium. We now know that radium is one of the long series of products of the radioactive transformation of uranium and exists in uranium minerals in about 1 part in 3 millions compared with uranium, and weight for weight shows an activity many million times that of uranium. The paper announcing this discovery was published in the *Comptes rendus* of 1898 under the names of M. and Mme. Curie and G. Bemont.

While at this stage, M. and Mme. Curie did all their scientific work together, it is natural to assume that Mme. Curie, as the chemist of the combination, was mainly responsible for the chemical work involved. She alone was responsible for the large-scale chemical work required to separate radium from radioactive residues in sufficient quantity to purify it and obtain its

atomic weight—a splendid piece of work for which she was awarded a Nobel Prize in 1911. It may be recalled here that Mme. Curie is the only recipient of a second award, for she shared a Nobel Prize with her husband and Henri Becquerel in 1904.

The discovery and isolation of radium was an event of outstanding significance to science from both the theoretical and practical points of view. The spontaneous emission of radiation from this element was so marked that not only was it difficult at first to explain but also, what was more important, still more difficult to explain away. The discovery of polonium and radium prepared the way for the ultimate explanation of radioactivity in terms of the spontaneous transformation of the radioactive bodies. Moreover, radium, in virtue of the radioactive emanation and other radioactive products into which it is transformed, has proved an invaluable source of great intensity for a study of the effects of the α-, β- and γ-rays in their passage through matter, and has thus played an important part in the growth of our knowledge of the internal structure of atoms in general. In addition, radium, in consequence of the highly penetrating γ-rays emitted from its products, has been widely used for therapeutic purposes and has proved an invaluable adjunct in the treatment of cancerous growths. Indeed, the greater part of the radium now separated on a commercial scale is utilised in the hospitals of the world for this purpose. Mme. Curie throughout her life actively promoted this use of her discovery to alleviate suffering, and during the War personally devoted herself to this remedial work—possibly at the expense of her own health.

Space does not allow me to mention more than a few of her numerous investigations in the field of radioactivity. She was for many years deeply interested in studying the chemical properties of the first element she discovered—polonium—and in developing methods for obtaining powerful sources of this element in the form of a thin film. Such active sources of polonium have proved of great use in later years in studying the transformations of matter by the action of α-particles, for the experiments are not complicated by the intense emission of β- and γ-rays which arise from sources like radium (B + C) and thorium (B + C). It was with the aid of these strong polonium sources that her son-in-law and daughter, M. and Mme. Curie-Joliot, have recently studied with such success the production of neutrons and induced radioactivity by the action of α-particles.

Mme. Curie retained her enthusiasm for science and scientific investigation throughout her life. She was an indefatigable worker and was never happier than in discussing scientific problems with her friends. All her publications are characterised not only by accuracy and skill in experimentation but also by marked critical power in the interpretation of the experimental results. Quiet, dignified and unassuming, she was held in high esteem and admiration by scientific men throughout the world, and was a welcome member of scientific conferences, in many of which she took an active part. She was a member of the Conseil du Physique Solvay from 1911 until her death. Since 1922 she had been a member of the Committee of Intellectual Co-operation of the League of Nations, and made many visits to Geneva.

The life of Mme. Curie was not without serious trials and tragedy, for her husband lost his life in a street accident in 1906. Immediately afterwards she was called to assume the directorship of the new Radium Institute named the 'Laboratoire Curie' which had been built specially for Pierre Curie and herself. She was made professor in the Sorbonne—the first time that a woman had gained this position. She was a clear and attractive speaker, and her lectures in the Sorbonne were widely attended not only by students of science but also by the educated public. In her later years, it was a source of pleasure and pride to her to watch the fine discoveries made by her daughter Irene and her daughter's husband in collaboration in her own laboratory. In a sense, history had repeated itself.

The importance of the pioneer work of M. and Mme. Curie in radioactivity was promptly recognised by the scientific world. In 1903, the Royal Society awarded them its Davy Medal. It is of interest to note that in 1903, M. and Mme. Curie came to London and M. Curie gave a lecture before the Royal Institution on the properties of radium. On this occasion, with the help of Sir James Dewar, the heat emission of radium at the low temperature of liquid oxygen was demonstrated for the first time. Mme. Curie was awarded numerous honorary degrees and was made honorary member of many societies both in Great Britain and abroad. In her last visit to England in 1929, she received the freedom of the city of Glasgow as well as an honorary doctorate of laws from the University. She was invited by the women of the United States to visit them in 1921 ; they presented her with a gram of radium in recognition of her discoveries, and in order to allow her to extend her investigations. She was everywhere received with great honour and repeated her visit in 1928.

The many friends of Mme. Curie throughout the world, who admired her not only for her scientific talents but also for her fine character and personality, lament the untimely removal of one who had made such great contributions to knowledge, and, through her discoveries, to the welfare of mankind.

RUTHERFORD.

We regret to announce the following deaths :

M. Benjamin Baillaud, honorary director of the Paris Observatory, and an associate of the Royal Astronomical Society, on July 8, aged eighty-six years.

Prof. F. W. Burstall, emeritus professor of mechanical engineering in the University of Birmingham, and vice-principal of the University in 1925–31, an authority on gas engines, on July 15, aged sixty-eight years.

News and Views

Progressive Industrial Chemistry

IN his presidential address to the Society of Chemical Industry at Cardiff on July 17, Dr. J. T. Dunn referred to the enormous growth of chemical industry since the early days of the Society. From being limited to the alkali industry, the soap industry, brewing and distilling, the metallurgical industries and, to a small extent, the manufacture of dyes it now covers not only great expansions and revolutionary developments in these industries but also the manufacture of synthetic drugs, the cellulose and plastics industries, the gas and coke industries, etc. One of the most potent factors in this change has been the growth of the idea that the chemist should have an authoritative position in regard to the conduct of a chemical industry. The idea that a chemist should be confined to the laboratory has largely passed, and chemists are now concerned not merely with routine testing of supplies and products but also with searching for improvements in processes and new directions for advance. They are as familiar with the details of the works as with the laboratory, and their opinion and advice are sought and regarded.

Fundamental Research

EQUALLY significant is the change that has taken place in the importance attached to research. Distinguishing between industrial or directed research and long-range investigations, Dr. Dunn, while stressing the value of the results obtained from the former which must always be carried on, stressed the value to industry of discoveries made in the first instance by men who are simply under the urge of inquiry into the working of Nature and have no industrial end in view. After citing a number of examples of important industrial developments based on such research, Dr. Dunn urged the encouragement of such fundamental investigations by competent staff both within industry and without, and pleaded for more determined effort to make known the scientific investigations which have made possible the sensational modern achievements in aviation, etc. When there is more wide-spread public appreciation of basic scientific work it will be easier to secure national support and recognition for chemical trading and research on a scale commensurate with their value to the nation.

Taxation and Scientific Research

IN an address recently delivered to the Association of Scientific Workers by its chairman, Mr. R. W. Western, attention was directed to the procedure in assessing income tax on commercial undertakings, whereby the position of scientific research as an aid in industry is seriously prejudiced. According to the present ruling of Inland Revenue officials, any expenditure on the scientific research incurred in connexion with a commercial or industrial undertaking is not counted as an expense which may be deducted from gross profits before assessment, but must be treated as capital expenditure and deducted from the amount available for distribution as dividend. Further, no allowance is made for depreciation of plant used in research, unless it is to be replaced—an obviously inappropriate condition. While it may be perfectly logical and in accordance with the strict principles of accounting to charge expenses of scientific research to capital, it offers a too obvious inducement to business concerns, when they have to meet their shareholders in these strenuous times to economise by cutting out research. In any event, it discourages co-operation between science and industry. Mr. Western's suggested 'Innovation Fund', free from tax, as a remedy for the situation has one feature which would be an undoubted advantage. This is the proposal that firms should publish particulars of their expenditure for purposes of scientific research, either singly or in groups. If to this could be added, without breach of confidence or revelation of trade secrets, some indication of the aims and achievement of such research, it would increase many-fold the interest of the general public in science. Information of this nature has always proved a readily absorbed item of news.

Scientific Research and Commercial Progress

LORD BLEDISLOE, in an address entitled "Some Reflections on the Economic Crisis" which he delivered to the Auckland Chamber of Commerce on May 31. 1934, said that whatever may be the ultimate remedies for the world's economic depression, no nation can anticipate assured participation in economic recovery unless it puts its own house in order by a policy of strenuous and persistent progress, an enlightened realisation of what is true economy, and an equitable and far-sighted assessment of the relative contribution to national wealth and popular well-being of all productive activities. First among the indispensable factors conducive to national prosperity are unflagging support of scientific research as applied to industrial production, distribution and transport, and systematic machinery for carrying ascertained knowledge, derived from such research and from the experience of successful enterprise, on to every farm and into every factory, mine, warehouse, shop and seaport throughout the country. Technical training has become more than ever essential to industrial success. A foreman or works manager will need in the future to know enough of science to appreciate intelligently, and be prepared to apply usefully, the work of the laboratory; and if he is to enjoy the sympathetic support of his employers, they too must have minds attuned to and biased in favour of scientific knowledge. Further, they must be prepared not only to encourage its prudent applications within their industrial ambit but also to make the voice of science more clamant in the councils of the nations.

To illustrate his thesis, Lord Bledisloe quoted the example of Denmark. Co-operation there has

not only been pursued in production, distribution and credit, thus eliminating a superfluity of handlings and middlemen's profits, but also the producers' organisations have taken over from the Government the task of controlling and directing the production, assembling, grading and exportation of butter, cheese, eggs and bacon. These processes have been thereby reduced to a fine art under the sympathetic supervision of a benevolent Government which has made science its watchword and consistently put a premium upon uniformity of output for export. It has preferred occupational community control rather than Governmental control in checking individual inefficiency. Of all the measures adopted to secure this objective, none has proved more salutary in maintaining a high average standard of husbandry than the system of peripatetic expert advisers, who periodically visit all the farms within their area and advise their occupants on the results of scientific investigation and the experience of others. The expenditure involved in providing for such advisory work is well worth while. To strengthen the backward, ignorant or inexperienced in some such way is the only sane alternative, since the ruthless abandonment to competition of weak human links has now fallen into disfavour.

Inland Water Survey

SIR HILTON YOUNG, the Minister of Health, who was accompanied by representatives of the various Departments concerned, received a deputation on July 17 from the British Association and the Institution of Civil Engineers. The deputation was introduced, in the unavoidable absence of Sir James Jeans, by Sir Henry Maybury, and there were present—Sir Percy Douglas, Sir Richard Redmayne, Prof. P. G. H. Boswell, Capt. H. McClean, Dr. Jeffcott and Dr. O. J. R. Howarth. The object of the deputation was to invite the Government to give favourable consideration to the institution of a complete and systematic survey of the water resources of the country, a subject on which a Committee of the British Association has recently published a report. The deputation suggested that the existing records both of surface water, including river run-off, and of underground supplies are very incomplete. They urged that systematic records comparable with those of rainfall are much to be desired and that a national survey is necessary in order to obtain statistics of this nature. Sir Hilton Young in reply thanked the British Association and the Institution of Civil Engineers for the consideration which has been given to the matter and for the suggestions which have been made, and said that these suggestions will receive the most careful consideration of the Government. He said that sources of information are available through the Ministry of Health, the Geological Survey and the Catchment Boards; and he suggested that the progress which is to be desired in the collection of statistics might perhaps be achieved by improving the existing means of gauging the flow of rivers and by improvements in the method of collecting and presenting returns.

Service Use of Petrol from Coal

UP to the present we have only touched the fringe of the possibilities presented by the production of petrol from coal, but the written reply given on July 11 by the Under-Secretary of State for Air to a question by Mr. Drummond-Wolff in the House of Commons is encouraging. Mr. Drummond-Wolff asked the Under-Secretary of State for Air the proportion of the total fuel consumption of the Royal Air Force which is fuel derived from British coal; whether it is intended to increase this proportion; and, if so, at what rate of increase. In reply, Sir Philip Sassoon said: "Seven squadrons are now flying on spirit derived from British coal, the consumption representing about seven per cent of the total quantity of aviation spirit used by the Royal Air Force at home. It is hoped to increase this proportion, but I cannot say at what rate it will be found practicable to do so."

Research in Abnormal Psychology

IT was suggested in a leading article in NATURE of December 23, 1933, that the scientific investigation of abnormal psychical phenomena might be undertaken in university departments or other institutions of learning in Great Britain. Particulars have now reached us of the formation for this purpose of a group, including some members of the University of London, under the title of the University of London Council for Psychical Investigation. The Council includes: Prof. F. A. P. Aveling, Dr. Guy B. Brown, Prof. Cyril Burt, Prof. J. C. Flugel, Mr. C. E. M. Joad, Mr. C. A. Mace, Prof. J. MacMurray, Dr. Eric D. Macnamara, Mr. S. G. Soal and Prof. E. S. Waterhouse. Mr. Harry Price, late director of the National Laboratory of Psychical Research, is the honorary secretary, and Miss Ethel Beenham (formerly secretary of the National Laboratory) has been appointed secretary. Through the generosity of Mr. Price, the new organisation has been equipped with the apparatus, instruments, workshops, records and research library belonging to his laboratory. We believe that the new Council is the first academic group in Great Britain formed to study the alleged phenomena of the séance room, and the first in any country to possess a laboratory specially equipped for the study of abnormal phenomena. The present address of the Council is 13D, Roland Gardens, South Kensington, London, S.W.7.

Ancient Monuments of Great Britain, 1933

IN accordance with their statutory obligation, the Commissioners of Works have published a list of protected ancient monuments which includes monuments added to those recorded in previous lists up to December 31, 1933 (London: H.M. Stationery Office. 1*s*. 3*d*. net). With a view to completeness, the Commissioners have included the names of monuments which are actually in their custody by deed of gift, deed of guardianship or by purchase. They are also responsible for other buildings or properties shown here which are not protected under the Act,

but are Crown property. The list now contains the names of no less than 3,600 monuments of all kinds, from prehistoric camps, stone circles and barrows to the remains of abbeys, castles, bridges, etc. Several of the buildings of historic interest are still in occupation, and Glasgow Cathedral and Dunblane Cathedral are also maintained by the Commissioners. Although, as is pointed out in an introductory note by the secretary to the Commissioners, the list cannot be regarded as complete or as covering systematically the whole of the more important ancient monuments of Great Britain, and although it is recognised that much has still to be done, it serves to indicate the wealth of antiquity that has been preserved, and the gratitude due to those who fifty years ago initiated the movement for the official preservation of historic monuments. In this connexion, however, and in view of the constant alarms as to the preservation of structures of historic interest in London, it may be noted that in Middlesex only two, and in London three, ancient monuments are recorded as under protection.

Civil List Pensions

AMONG the Civil List pensions just announced as having been granted on March 14 last are the following :—Mrs. Abbott, in recognition of the services rendered by her husband, the late Mr. W. J. Lewis Abbott, to geology and prehistoric archæology, £110 ; Mrs. Cantrill, in recognition of the services rendered by her husband, the late Mr. T. C. Cantrill, to prehistoric archæology, £60 ; Mrs. Hart, in recognition of the services of her husband, the late Dr. D. B. Hart, to gynæcology, £80 ; Mrs. Stapf, in recognition of the services rendered by her husband, the late Dr. Otto Stapf, to botanical science, £90.

Cattle Diseases and Milk Production

TOWARDS the end of 1932, a committee of the Economic Advisory Council was appointed by the Prime Minister to formulate measures to reduce disease among milch cows in Great Britain, for reducing bovine tuberculosis and for improving the milk supply, and to report upon any administrative changes that may be desirable. The report of this Committee, presided over by Sir Frederick Gowland Hopkins, has now been issued (Economic Advisory Council. Report of Committee on Cattle Diseases. London : H.M. Stationery Office. 2*s*. 6*d*. net). In the first part, the production and distribution of milk and their relation to cattle diseases and public health are considered. The second part is devoted to a discussion of possible lines of administrative development. In part 3 the Committee's various recommendations are set out in detail, and these with the principal conclusions are summarised in part 4. Owing to the ravages of disease, the useful life of a dairy cow, instead of extending over eight or nine lactations, averages only about 4½ years, the principal diseases causing this wastage being contagious abortion, tuberculosis, mastitis and Johne's disease.

THE effects of pasteurisation are surveyed, and the disadvantages are considered to be too small to outweigh the great advantage of protection from infection. Pasteurisation, however, should be permitted only in approved and tested plants, which should be frequently inspected officially by the sanitary authority during working. For the grading of milk, four new designations are suggested to replace those already existing. The principal measures proposed for improving the milk supply are (1) an extension of routine veterinary inspection, (2) an active policy for the eradication of bovine tuberculosis, and (3) the bestowal upon certain urban authorities of the right to require pasteurisation of all milk sold within their boundaries which is not either certified or grade A, tuberculin tested. Owing to variations in potency of commercial tuberculins, it is recommended that the Ministry of Agriculture and Fisheries should approve a standard for tuberculin, the product to be sold only to qualified veterinary surgeons.

Researches in Pathology

THE latest number of the *Journal of Pathology and Bacteriology* (**39**, No. 1, July, 1934), a handsome volume of some 250 pages with 52 plates, was issued on July 5 as a birthday greeting to Sir Robert Muir, professor of pathology in the University of Glasgow, on his seventieth birthday. Written entirely by his pupils, it is a fitting tribute to the widespread influence of the doyen of British pathology, and no other of our schools of pathology could have done the like for its revered leader. It contains nineteen substantial contributions to knowledge from a dozen different centres, and among the authors are ten professors of pathology or bacteriology. They cover roughly the whole range of subjects with which pathologists concern themselves. This is a far greater testimony to Sir Robert's power as a teacher than if his disciples were pursuing nothing but his own special interests. The Glasgow school and its leader are still as vigorous as ever, and everyone will wish them well.

The Colorado Beetle

AN article by Mr. J. C. F. Fryer in the *Gardener's Chronicle* of June 23, 1934, issues a note of warning about the possible spread of the Colorado beetle in Great Britain. For long periods our potato crops remained free from attack by this pest, and even when it appeared at Tilbury in 1901, it was quickly eradicated. Since the War, the beetle has established itself in France, and in August 1933 it re-appeared at Tilbury. Drastic measures to prevent its spread were taken immediately, and whilst it seems possible that they were successful, Mr. Fryer appeals to potato growers to maintain a careful watch for the conspicuous beetle. Partially eaten potato foliage suggests its presence, and close examination should be made for the insect. It has wing cases striped longitudinally with black and yellow, and is about half an inch long. That the pest has not yet established itself in Great Britain is a matter for congratulation, but continued freedom demands close co-operation from growers. Attacks in their early stages can be controlled with comparative ease, but when a colony is well established, it may have sent individuals to found other colonies.

St. Paul's School Field Club

THE fiftieth anniversary of the moving of St. Paul's School from the City of London to West Kensington, on the western border of Greater London, coincides with the opening of the new biological laboratories. The occasion was celebrated at Apposition on July 5, when the Field Club held an exhibition of its work. After the speeches, the display was visited by the High Master, the Governors of the School and many hundreds of boys and parents. The numerous exhibits indicated how wide are the interests of the members, in all branches of biology and natural history. Worthy of special mention were a large number of experiments in plant physiology, an investigation of irregular nutrition in plants (mycorrhiza, saprophytes and parasites), an ecological survey of sea-shore life and a study of heath and moorland associations, with special reference to mosses. Collections were shown of insects, ferns, seaweeds and fresh-water organisms, while a spirometer proved very popular. The Club, which is nearing its fortieth anniversary, has always been a great boon to the naturalists of the School, and in recent years has worked in close co-operation with the Biological Department. A great deal of field work is done, and in the winter, lectures are given by members and others on subjects of which they have made a special study. The Club is exceptionally fortunate in being at the same time within easy reach of the countryside and the authorities at the Natural History Museum, Kew Gardens and the Zoo.

Harvey and Literature

THE June issue of the *Proceedings of the Royal Society of Medicine* contains a paper read by Dr. D. F. Fraser-Harris before the Section of the History of Medicine on William Harvey's knowledge of classical, medieval, renaissance and contemporary literature. Harvey's acquaintance with classical literature is shown by the fact that his works contain references to twenty-five Greek writers ranging from Thales in the seventh century B.C. to Suidas, who flourished about A.D. 975, and including among others Hippocrates, Plato, Euclid of Megara, Erasistratus, Aristotle and Menander, as well as allusions to fourteen Latin writers from Virgil to Pipinus and Migaldus, including Varro, Terence, Seneca, the elder Pliny, Celsus and Ulpian. Three medieval writers are mentioned by Harvey, namely, Avicenna, Averroes and Albertus Magnus. Of the thirty-two renaissance and contemporary authors whom he quotes, the best known are Jacobus Sylvius, Fracastor, J. C. Scaliger, Fernel, Vesalius, Eustachius, Descartes, De Thou, Sennert, Pecquet, Baillou and Riolan. The only English writer mentioned is Francis Bacon, whose phrase "to enter upon our second vintage" is quoted in *De Generatione*. In the manuscript notes to his lectures, Harvey also cites seven authors whom he mentions nowhere else, namely, Plautus, Horace, Cæsar, Cicero, Vitruvius, Nicolas Massa and Archangelo Piccolhomini. Most, but by no means all, of the references are to subjects of biological importance, the exceptions being passages in the Eclogues, Georgics and Aeneid of Virgil and Terence's *Adelphi*. The conspicuous absence of any mention of Cæsalpinus, whom many Italian physiologists even to-day regard as the discoverer of the circulation of the blood, and of Servetus, in Harvey's writings is attributed by Dr. Fraser-Harris to the fact that all but three copies of Servetus's book had been burned with him at the stake and that Harvey had found nothing of real value in Cæsalpinus's work.

History of Organic Analysis

PRIOR to the introduction of elementary organic combustion analysis early in the nineteenth century, organic matter was analysed, over a period of nearly two centuries, by dry distillation, the results being expressed in weighed fractions of gaseous part, phlegma, oil and carbon residue, or later as carbonic oxide, carbonic acid, water, empyreumatic oil, acidic fraction, carburetted hydrogen and charcoal. The germ of this method is found in Beguin's "Élémens de Chymie", 1615. Nierenstein (*Isis*, 21, 123; 1934) has shown that there was a period of transition between the old and new methods of analysis, represented by a work of Nees von Esenbeck, Bischof and Rothe, "Die Entwickelung der Pflanzensubstanz", Erlangen, 1819, a rare book which is otherwise of considerable interest in the history of plant chemistry This contains tables, from which the chemical formulæ may be deduced from the results of distillation analyses, containing 981 'complexions' of the five binary compounds of oxygen, hydrogen and carbon, namely, water, carbonic oxide, carbonic acid, olefiant gas and marsh gas. These tables were the precursor of Richter's percentage tables now widely used.

Wireless Communication and the Mercantile Marine

THE wireless communications of the mercantile marine are subject to regulations issued by the administrations of the maritime nations, which in turn are governed by the relevant parts of the General Radio Communication Regulations attached to the current International Telecommunication Convention which came into force on January 15, 1933. These regulations lay down the purposes for which the various bands of frequencies may be employed, certain bands being allocated exclusively to the mercantile marine, others to mobile services generally, while some are shared between mobile and other services. A certain amount of difficulty has been experienced in carrying out the communications of the mercantile marine owing to the interference which exists, especially in some areas near the coasts of Europe and the United States. In a paper read before the Wireless Section of the Institution of Electrical Engineers on May 2, Commander J. A. Slee made an analysis of the sources of this interference. Typical response curves of the average ship's receiver were given in the paper, and from these the field strengths of signals which can cause interference in the different sections of the marine communication band have been computed. The analysis dealt with both spark and valve transmitters, and also with the possible interference which

might arise from the large number of fixed beacon stations now in operation for the use of ship direction-finders. Although these beacons are located in a restricted band of wave-lengths, it has proved possible to utilise different modulation note frequencies, and it is considered that as at present organised, mutual interference between beacon stations is negligible.

Interference with Broadcast Reception

THE problem of the elimination of the interference caused to broadcast reception by electrical machines and apparatus is of widespread interest and is being studied in many countries. A Conference has been held in Paris recently under the auspices of the Electrotechnical Commission, at which representatives of various international electrical and broadcasting organisations were present. A brief report of the results of this Conference is given in *World Radio* of July 13. It was agreed that no protection need be considered at the present time for the case of a wanted signal strength of less than 1 millivolt per metre, and that the interference should be considered relative to a signal carrier wave of this intensity, modulated to a mean depth of 20 per cent. Under these conditions it was considered desirable, if reception free from interference is to be obtained, that the level of the interference field should be 40 db. below that of the wanted signal. At the present time, it would appear to be difficult and premature to fix a definite, practical value applicable to electrical installations, until further experimental data on this aspect of the problem have been obtained.

ONE of the difficulties accompanying legislation in this subject is the interpretation of the results of measurements of interference obtained by different methods. Three main methods are already in use in different countries for evaluating the relative magnitude of interference, these being known as the French, German and British methods respectively. At the Paris Conference it was agreed that a comparison of these three methods should be carried out in Berlin in October next by a group of five experts assisted by the General Secretary of the I.E.C., with the view of proposing that one of these or some alternative method should be adopted for international use. The British interests in this matter of interference reduction are safeguarded by the Radio Interference Committee of the Institution of Electrical Engineers in co-operation with the British Standards Institution, and these bodies were largely responsible for the success of the recent meeting in Paris.

Congrès Préhistorique de France

A CORDIAL invitation to attend the eleventh Prehistoric Congress of France is extended to all archæologists by its president and officers. The Congress is to be held at Perigueux on September 16–22. A special interest is attached to this meeting of the Congress, as it was at Perigueux thirty years ago that the Congress met for the first time. It had been constituted in the previous year on the proposal of MM. Émile Rivière and Marcel Baudouin, by the then recently founded Société Préhistorique de France. Its meetings were interrupted by the War and were resumed in 1931. The present session will be the first since that date. Apart from its sentimental interest, the meeting is of importance as taking place in the heart of the classical territory of prehistoric study, in which the evidence for the art and industry of palæolithic man abounds. It is appropriate, therefore, that the Conseil Général of la Dordogne will join with the Municipality of Perigueux in offering a welcome to members of the Congress. The Congress will meet under the presidency of Dr. Felix Regnault. The honorary general secretary and treasurer is M. Charles Schleicher, treasurer of the Société Préhistorique. The arrangements are in the hands of a strong local committee. So far as at present arranged, the subjects to which special attention will be devoted in the communications submitted to the Congress are the palæolithic period in the region of meeting, the mesolithic and neolithic of the Dordogne, and artificial caves and souterrains. The principal sites of interest in the area will be visited and excavations demonstrated in the course of the meeting. Notifications of desire to attend, subscriptions (Membre titulaire, 30 fr., Membre titulaire souscripteur, 100 fr., Membre adhérent, 20 fr.), communications, etc., should be addressed to M. Ch. Schleicher, 9, rue de Verneuil, Paris (vii).

Medical Aspects of Physical Culture

AN International Congress of Medicine applied to Physical Education and Sport will be held at Chamonix on September 3–5 under the presidency of Prof. A. Carnot of Paris. It has been organised by Prof. A. Latarjet, of Lyons, president of the International Association of Sport Medicine, as the result of a Congress held at Turin in 1933. The Congress will consist of the following sections with their special presidents : Biology (Prof. H. Laugier), Medicine and Pædiatrics (Dr. Jules Renault), Surgery and Orthopædics (Prof. L. Rocher), Physical Education during and after the School Period (Prof. Chaillet-Bert), and Sport Medicine (Prof. Grégoire). The following questions will be discussed before the united sections : biometrical standardisation of sport, medical control of physical education and sport, and medical indications for treatment at high altitudes. The object of the Congress is to secure the co-operation of biologists, clinicians and sportsmen and to further the scientific and social development of physical education. Further details of the Congress will be published later. The general secretaries are Dr. Godlewski, 14 rue Théodule Ribot, Paris, and Prof. Cordier, 1 rue Childebert, Lyons. The regional secretary is Dr. Agnel, Chamonix.

Faraday Society Discussion on Colloidal Electrolytes

A PRELIMINARY programme is now available of the General Discussion on Colloidal Electrolytes to be held by the Faraday Society at University College, London, on September 27–29. Prof. H. Freundlich will deliver an introductory paper, and papers in the remaining sessions will be grouped according as they

deal with theory, experimental technique or special subjects (soaps, dyestuffs, silicates, proteins, and so on). The papers, which will be available in advance, will be taken as read; each author will indicate a few points of special interest, after which the subject will be open for discussion. Among those outside Great Britain who are contributing papers are Dr. E. J. Bigwood (Brussels), Prof. P. Debye (Leipzig), Prof. E. Elod (Karlsruhe), Prof. A. Frumkin, Dr. Proskarnin and Prof. A. J. Rabinovith (Moscow), Prof. E. Hammarsten (Stockholm), Prof. H. R. Kruyt (Utrecht), Prof. Linderstrom-Lang (Copenhagen), Prof. A. Lottermoser (Dresden), Prof. J. W. McBain, Mrs. M. E. Laing McBain and Margaret M. Barker (Stanford University), Prof. W. Pauli (Vienna), Prof. M. Sameč (Ljubljana), Prof. A. Treadwell (Zurich) and Dr. F. Valko (Ludwigshafen a/Rh.).

Annals of the Transvaal Museum

THE Committee of the Transvaal Museum has just published, through the Cambridge University Press, indexes to all the volumes of the *Annals* from vol. 6 (1917–20) to vol. 11 (1924–26). The indexes are thorough guides to the systematic contents of the volumes, and show new genera, subgenera, species, subspecies and the main reference in heavy-faced type. But they do not contain authors' names or titles of papers contained in the volumes.

Announcements

THE Lord President of the Council has appointed Mr. E. Barnard to be director of food investigation in the Department of Scientific and Industrial Research, and Dr. F. Kidd to be superintendent of the Low Temperature Research Station, Cambridge. Both these posts were previously held by the late Sir William Hardy. Mr. Barnard has been assistant director of food investigation since 1931. He joined the Department of Scientific and Industrial Research on entering the Civil Service in 1919. Dr. Kidd, who has been on the staff of the Low Temperature Research Station since its establishment in 1922, has been engaged on food investigation work in the Department since 1918.

DR. MINORU MASHINO, a research chemist in the Tokyo Imperial Industrial Research Laboratory, has been awarded the medal for "special merit in research" of the Society of Chemical Industry, Japan. For many years, Dr. Mashino has made valuable investigations on the proteins of the soya bean.

THE Engineer's German Circle has arranged a tour of Germany to be held on August 30–September 7. Several places of technical interest will be visited. Further information can be obtained from the Amerop Travel Service Inc., 66, Haymarket, London, S.W.1.

IN a pamphlet of 30 pages, entitled "Practical Physiology of the Sense Organs", Dr. R. J. Lythgoe has aimed at collecting under one cover all the profitable exercises to be found in a scattered literature (Oxford University Press. London: Humphrey Milford, 1934. 1*s*. net). The author describes simple experiments on the sense organs which need a minimum of apparatus and preparation. The descriptions are as brief as possible, and are supplementary to the material found in theoretical textbooks. The total time required for the course is about 12 hours.

MESSRS. BERNARD QUARITCH, LTD., 11, Grafton Street, London, W.1, have issued Catalogue No. 489, "A Catalogue of Books and Periodicals on Aeronautics, Astronomy, Chemistry, Electricity, Engineering, Fortification and Gunnery, Horology, Mathematics, Meteorology, Mining and Minerals, Navigation, Physics, Pyrotechnics, Surveying, etc." This contains nearly 600 items. It includes many scarce and important early works on the mathematical and physical sciences, among which may be mentioned a first edition of Newton's "Principia"; the first English translation of Euclid's "Elements"; and early treatises on magnetism, by Peregrinus, Barlow and others. A number of valuable sets and long runs of important scientific periodicals are offered. These include the *Philosophical Transactions of the Royal Society*, complete and unabridged from the commencement in 1665 to 1933.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in mechanical engineering at the Harris Institute, Preston—The Principal (July 24). A lecturer in chemistry at the Leeds College of Technology—Director of Education, Leeds (July 24). A lecturer in electrical technology and power at the Municipal College, Burnley—Director of Education, Burnley (July 25). A principal of the Municipal Technical School, St. Helens—Education Officer, St. Helens (July 27). An assistant (Grade II) in the Admiralty technical pool for duty at the Admiralty Compass Department at Slough—Secretary of the Admiralty (C.E. Branch), London, S.W.1 (July 28). Eleven surveyors of works in the Military Engineer Services Establishment, India—The Under-Secretary of State for India, Military Department, India Office (July 28). Two assistant marketing officers in the Ministry of Agriculture and Fisheries—Secretary (July 30). An instructor in the Navigation Department, Merchant Venturers' Technical College, Bristol—Principal (July 30). A lecturer in mechanical engineering at the Municipal Technical College, Hull—Director of Education, Hull (Aug. 1). A lecturer in mechanical engineering at the Municipal Technical College, Hull—Director of Education, Guildhall, Hull (Aug. 1). A principal of the Carlisle Technical School—Director of Education, Carlisle (Aug. 8). A principal of the Widnes Municipal Technical College—Secretary, Education Office, Town Hall, Widnes (Aug. 31). A reader in industrial hygiene and medicine in the University of Birmingham—Secretary (Sept. 1). Full-time appointments in engineering subjects at the County Technical College, Mansfield, Notts—The Principal. A mechanical draughtsman on the Singapore Harbour Board—Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M/3446.

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.*]

Possibility of Sedimentation Measurements in Intense Centrifugal Fields

THE ultracentrifugal technique worked out in this laboratory enables us to carry out measurements of sedimentation velocity and sedimentation equilibrium in very powerful centrifugal fields[1]. At the present time, routine work can be done at speeds up to 74,000 r.p.m. with a column of solution 12 mm. in height situated 65 mm. from the centre of rotation. The centrifugal force in this case corresponds to 400,000 times gravity. When it comes to the study

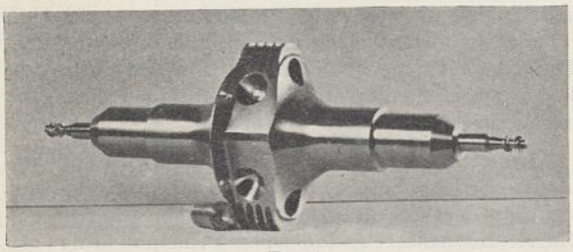

FIG. 1.

Rotor (weight 2,500 gm.) and cell (weight 12·5 gm.) for sedimentation measurements up to 900,000 times the force of gravity; the two twin-turbines at the ends of the shaft are fed with oil at a pressure of 15 kgm./cm.²; the rotation takes place in hydrogen of 20 mm. pressure.

of substances of comparatively low molecular weight, for example, 1,000 or 2,000, and when one wishes to make a sedimentation analysis of mixtures of low molecular weight, such as the decomposition products of the proteins, it is of importance to have at one's disposal centrifugal fields of still higher intensity. We have therefore tried to improve our technique in this direction.

Last autumn a rotor was made for carrying a cell containing a column of solution 6 mm. in height at a distance of 36 mm. from the centre of rotation. It was successfully tested at 135,000 r.p.m. (750,000 times gravity) but exploded later, during a run at 125,000 r.p.m. (625,000 times gravity). The experiment showed, however, the possibility of regular sedimentation measurements at this speed. This spring, a new rotor of about the same dimensions, but of better material and improved construction, was therefore designed for a cell carrying a column of solution 8 mm. in height at 36 mm. from the centre of rotation (Fig. 1). It was tested at 160,000 r.p.m. (1,100,000 times gravity) and successful runs on hæmoglobin were carried out at a speed of about 145,000 r.p.m. (Fig. 2). The rotor finally exploded during one of these runs.

The fact that the cell with its windows of crystalline quartz withstood the strains and that convection-free sedimentation was obtained shows that accurate measurements may be performed in centrifugal fields of the order of one million times the force of gravity. We feel sure that it will be possible to improve further the mechanical design and to utilise to

FIG. 2.

Sedimentation of dilute human hæmoglobin in the centrifugal field 900,000 times the force of gravity; time between exposures—3 minutes; the sharpness of the boundary between solvent and solution demonstrates the perfect homogeneity of this protein.

advantage the convection-free sedimentation which has been demonstrated to take place even in these very intense centrifugal fields under the experimental conditions realised in our ultracentrifuge.

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June 21.

[1] NATURE, **123**, 871, June 8, 1929. *Chem. Rev.*, **14**, 1; 1934. *Science*, **79**, 327; 1934. *Koll.-Z.*, **67**, 1; 1934. *Naturwiss.*, **22**, 225; 1934.

Fluorescent Yield of X-Ray Emission

ONE of the chief reasons for the low intensity of the X-ray lines emitted by light atoms is the low fluorescent yield of the X-ray emission by such atoms. As predicted by Rosseland and first shown by Auger, excited atoms when reorganising can dispose of their excess energy either by emitting X-ray quanta or by giving off photoelectrons. When

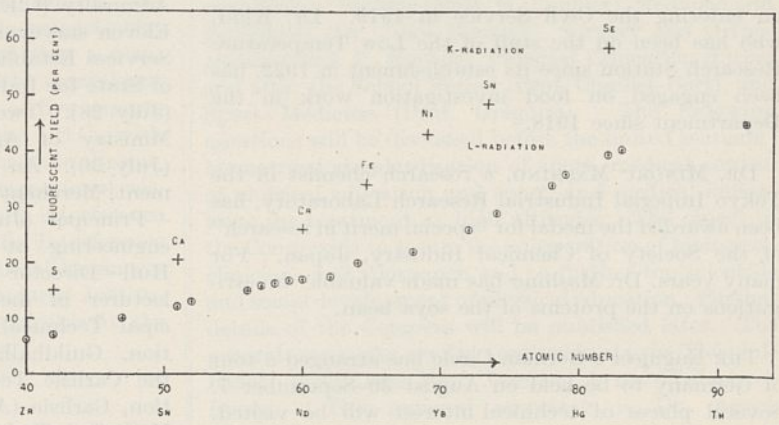

FIG. 1. *L*-radiation yield of the elements 40–92. The graph also shows the *K*-yield of the elements emitting a *K*-radiation of corresponding wave-length.

the latter process prevails, the yield of X-ray emission is low, and vice versa. The magnitude of the yield can be determined by counting the number of photoelectrons[1] given off by the atoms when leaving the excited state, or by comparing the intensity of the exciting and the excited radiation.

It was chiefly the last-mentioned method which was used to determine the fluorescent yield of the K-emission in numerous cases[2], the intensities being measured by the ionisation method. We determined the fluorescent yield of the L-emission of a great number of elements and that of the K-emission for several cases by using a photographic method worked out by E. Alexander and one of the present writers[3].

The results obtained are to be seen from Fig. 1, which shows an increase from 6 to 45 per cent of the fluorescent yield of the L-radiation when proceeding from zirconium (40) to uranium (92). In the same graph some values found for the K-radiation yields are also plotted.

When a K- and an L-radiation of equal wave-length are compared, the yield of emission is markedly greater in the first case, the ratio being as much as 1·75 : 1, for the wave-length 3300 X.U. We determined also the M yield in the case of uranium and found it to be 6 per cent. The comparison of the fluorescent yield of the K-radiation of potassium with that of the L-radiation of silver and the M-radiation of uranium, all these radiations having about the same wave-lengths, shows the ratio 18 : 10 : 6.

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June 15.

[1] P. Auger, *Ann. Phys.*, **6**, 183; 1926.
[2] Comp. especially L. Martin, *Proc. Roy. Soc.*, A, **115**, 420; 1927. A. H. Compton, *Phil. Mag.*, VII, **8**, 961; 1929. G. L. Locher, *Phys. Rev.*, **40**, 484; 1932. M. Haas, *Ann. Phys.*, **16**, 473; 1933. D. K. Berkey, *Phys. Rev.*, **45**, 437; 1934.
[3] G. v. Hevesy and E. Alexander, *Die Naturwissenschaften*, **19**, 825; 1931.

Polarisation and Spectrum of the Sky Light during the Total Solar Eclipses of August 31, 1932, and February 14, 1934

EARLIER observations of the polarisation of the sky light during solar eclipses do not agree[1]. New observations were undertaken in connexion with my polarisation measurements of the solar corona. I observed, during the 1932 eclipse at Gray, Maine, a point of the sky at a distance of 8° from the sun at mid-totality. A Martens polarisation photometer was used, mounted rigidly. The sky was perfectly clear. Whereas comparison curves obtained on several days before and after the eclipse show smooth curves, the polarisation curve of the eclipse day reveals a considerable *increase of polarisation* during totality. These measurements were repeated during the 1934 eclipse observed at Losap Islands, in the South Seas. Again a point was observed at a distance of 8° from the sun at mid-totality. A half-shadow polarimeter was used. The sky was perfectly clear. The results obtained show again the increase of polarisation during totality against the comparison days.

The *plane of polarisation* of the 8° point shows a smooth change during the comparison days, according to the position of the sun. During totality, however, a *rotation* of the plane was observed amounting to several degrees from the strictly radial polarisation observed otherwise.

In 1934, thirteen spectra were taken of the sky light before, during, and after the eclipse on two backed Agfa Superpan plates. A Hilger grating spectrograph was used (dispersion 49·4 A./mm.), the instrument being pointed towards the same 8° point of the sky as the polarimeter. The spectrograph was carefully protected against light from other parts of the sky. Intensity squares and comparison spectra were printed for photometric reduction of the plates, both with a neutral and a step wedge. Comparison spectra of the sky light were taken during two days. Microphotometer records of the spectra show a good agreement in the intensity distribution, except in those spectra obtained shortly before and after totality, the spectrum obtained during totality being too faint for accurate measurement. The spectrum before totality reveals the appearance of a *new maximum* extending photographically from 5910 A. to 6150 A. This maximum seems to appear also in the spectrum after totality. A second new maximum appears faintly in the spectrum before totality in the region 4610–4700 A.

It seems worth while to check this change of the spectrum of sky light in future eclipses, using glass and quartz spectrographs of higher light power. A confirmation of the new maxima would, together with the rotation of the plane of polarisation, point to the presence of a self-luminescent component in the sky light, besides scattered light of the sun according to the Tyndall–Rayleigh law. The self-luminescence may be explained by electron impact of gases of the atmosphere such as has been shown under laboratory conditions[2].

I am obliged to Profs. A. C. Hardy of Massachusetts Institute of Technology, and C. L. A. Schmidt of the University of California, and to Mr. H. Spindler of San Francisco, for loan of instruments, to Mrs. R. N. Mayall of Harvard College Observatory, Mrs. W. M. Cohn, and Mr. T. Hirai, of Kyoto Imperial University, for assistance. The 1932 work was supported by grants from the Rumford and Permanent Science Funds of the American Academy of Arts and Sciences. The Imperial Japanese Government kindly furnished transportation facilities to and from Losap Islands, and extended many courtesies to the 1934 expedition.

WILLI M. COHN.

Berkeley, California.
May 9.

[1] H. H. Turner and H. F. Newall, *Proc. Roy. Soc.*, **57**, 346; 1900. H. F. Newall, *Mon. Not. Roy. Astron. Soc.*, **66**, 475; 1906. N. E. Gilbert and J. J. Few, *Publ. U.S. Naval Observ.*, **4**, IV, *D* 218; 1906. N. E. Gilbert, *ibid.*, **10**, *B* 192; 1926.
[2] W. M. Cohn, *Z. Phys.*, **75**, 544; 1932.

Atomic Radius of Fluorine

FOR reasons explained in a forthcoming paper, I suggest the use of the term 'di-atom' in place of 'diatomic molecule' in spectroscopic nomenclature.

By an application of the modified Morse formula[1], I have 'predicted' the equilibrium nuclear distances of 36 electronic levels of non-hydride di-atoms. It is hoped to apply these results in the construction of potential energy-nuclear distance curves.

The equilibrium nuclear distance of F_2 (in $^1\Pi$ state*) is found to be 1·331 A., giving an atomic radius of 0·67 A. This is in exact agreement with W. L. Bragg's original estimate[2], from crystal data, whilst a more recent value, due to Neuberger[3], is 0·68 A.

The agreement between experiment and calculation appears somewhat striking, especially when the two following facts are taken into account: (1) The value of ω_e on which the calculation is based refers to band-head measurement[4]; (2) extrapolation is involved from the 12th to the 14th molecular group. The modified formula thus appears to survive a sufficiently severe test.

* The lowest state for which measurements are recorded.

I have also found the modified expression to be applicable to hydride di-atoms in the period from LiH to FH. Morse's function, far from remaining constant, is definitely periodic in the earlier periods of both hydride and non-hydride di-atoms.

C. H. DOUGLAS CLARK.

Department of Inorganic Chemistry,
University, Leeds, 2.
June 20.

[1] C. H. Douglas Clark, NATURE, **133**, 873, June 9, 1934.
[2] W. L. Bragg, *Phil. Mag.*, vi, **40**, 169; 1920.
[3] N. V. Sidgwick, "The Covalent Link in Chemistry" (Cornell University Press, 1933) (see Table XVIII on p. 85).
[4] W. Jevons, "Report on Band-spectra of Diatomic Molecules" (Cambridge University Press, 1932) (see Appendix II, p. 280).

L Absorption Spectra in the Very Soft X-Ray Region

THE L_{III} absorption edges of aluminium and magnesium have been measured. Since the continuous X-ray spectrum in this region (above 100 A.) is very feeble, I have used optical spark spectra from elements giving spectra rich in lines. As source for the spectra reproduced in Fig. 1 a spark between copper electrodes was used. The apparatus was a concave grating spectrograph with a glass grating, ruled at this laboratory, of radius 1 m., 288 lines per mm.

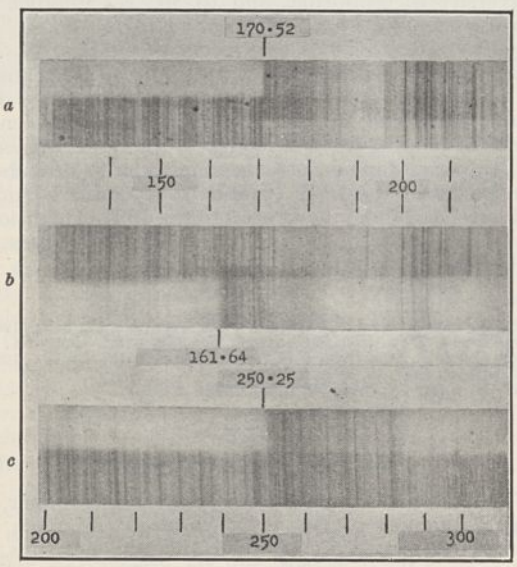

FIG. 1. L_{III} absorption limits of (*a*) Al, (*b*) Al in Al_2O_3, and (*c*) Mg.

The thickness of the foils used was for aluminium 0·5 μ and for magnesium about 0·3 μ. The magnesium was deposited on a 0·5 μ aluminium foil. The wavelengths for the copper lines in this region being known[1], the edges were measured relative to those lines. The L_{III} absorption limit of Al was found to be 170·52 A., giving $\nu/R = 5{\cdot}344$. The corresponding value for Mg was 250·25 A., $\nu/R = 3{\cdot}641$.

I have also measured the L_{III} absorption edge of Al in Al_2O_3 (Fig. 1, *b*). The value found is 161·64 A.

A detailed report will be given elsewhere.

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May 29.

[1] Kruger and Cooper, *Phys. Rev.*, **44**, 826; 1933.

Heat Flow during Surface Colour Formation

WHEN gaseous substances slowly react with metals, and the volume of the solid resultants is greater than that of the metal at the temperature of reaction, a series of bright interference colours is generally produced. Some anomalous features are shown, however, when the dynamics of the formation of the films are considered, and occur generally independently of the gaseous reagent and the nature of the solid metal. The rate of formation slows down faster than described by the laws of diffusion through a thickening film at constant temperature, and, further, if the gaseous reactant be removed, causing the interruption of the reaction, the speed at which the reaction re-occurs diminishes. The longer the time of arrest the more marked is the slowing down, and in some cases, for example, temper colours on steel, the colour appears to be fixed.

The molecular heat evolution in this type of reaction is large, but the films are so thin that ordinary methods fail to detect the heating, and in reactions at room temperature the film is cold if touched. While the reaction is proceeding, the film is separated from the metal by an interface at which the heat evolution is proceeding, and a partition of the heat evolved occurs, the metal taking most by reason of its large thermometric conductivity. On account of the relatively enormous mass of the metal, it appears little altered in temperature. The interference film is thin, and the heat remaining in it, though much less than that flowing into the metal, produces a marked elevation of the temperature while the film is forming.

The order of the effect for iron, nickel and copper, when one oxide colour sequence is produced in about two minutes, is 20° C. for copper oxide, 50° C. for nickel oxide, and 90° C. for an iron oxide film. Thus the diffusion of the reactants through the oxide film is cut down by a purely physical cause if the reaction be arrested, since the film can then attain the temperature of the mass of metal relatively quickly. In each case after interruption the same velocity can only be attained again by raising the temperature, and the rise in temperature necessary after a considerable interruption is of the same order as the original elevation of the temperature of the film before the reaction was stopped.

In the same way, the dynamics of the slow attack of gaseous reagents on metals is complicated by the initial higher temperature of the interference film falling when the rate of evolution of heat at the interface becomes comparable with the rate of flow of the heat stored in the interference film through the massive metal. The fall of the velocity under these conditions is thus autocatalytic, and affords a ready explanation of the fact that sometimes experience leads to the association of a definite colour of the final film with a definite temperature for the plane surfaces of massive metal. The greater the molecular heat of reaction, and the smaller the difference between the thermometric conductivity of the metal and the interference film, the more noticeable becomes the fixed colour at a fixed temperature in the range of temperatures in which the attack is slow.

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Magnetic Properties of Benzene Vapour

FROM a theoretical point of view it may be expected that the molecular susceptibility of benzene will remain almost unaltered when the substance passes from the liquid to the vapour state. The available experimental data show, however, a distinct divergence between the susceptibility values of those two aggregate states of benzene. While the molecular susceptibility of the liquid as measured by Pascal and others is equal to 57×10^{-6}, the data obtained by Vaidyanathan[1] for the vapour state reach 83×10^{-6}. The difference between the two values, as, for example, pointed out by E. C. Stoner[2], is much too great to be accounted for by the adopted model of the benzene molecule.

As the values of the susceptibility of the liquid obtained by different authors agree very well with the value given by Pascal, it seemed to us necessary to repeat the measurements on benzene vapour only. A new method recently developed in this laboratory[3] permitted us to make absolute measurements of the susceptibility of different gases and vapours with a sufficiently high precision. We investigated the magnetic properties of benzene vapour carefully dried and purified *in vacuo*. The value of the susceptibility of the vapour obtained by us is equal to $59 \pm 3 \times 10^{-6}$. This agrees very well with that adopted for the liquid, namely, 57×10^{-6}.

Thus it seems that the difficulty concerning the magnetic properties of benzene was mainly based on some mistake in the experimental work. Our measurements are being continued, and we hope shortly to publish elsewhere more precise data concerning this problem.

R. JAANUS.
J. SHUR.

Physical Technical Institute
of the Ural,
Sosnovka 2, Leningrad, 21.
May 29.

[1] V. J. Vaidyanathan, *Phys. Rev.*, **30**, 512; 1927.
[2] E. C. Stoner, "Magnetism".
[3] *Comptes rendus de l'Academie des Sciences de L'URSS*, in print.

Fluoride as an Impurity in Sodium Phosphate

SINCE fluoride has a strongly inhibiting effect on many enzymes, its unsuspected presence, even in small amount, may cause serious disturbance in biochemical work. It may be well, therefore, to direct the attention of biochemists to the fact that some samples of sodium phosphate contain fluoride. Recently in this laboratory it was found that a specimen of 'sodium phosphate recryst', purchased in the ordinary course as a reagent, strongly inhibited alcoholic fermentation by dried yeast. On examination it was found that fluoride was present in sufficient quantity to be easily detected qualitatively. Judging by its biochemical effect, about 0·1–0·5 per cent of fluoride (as sodium fluoride) must have been present in the sodium phosphate, but no quantitative chemical estimation was made. A single crystallisation of 25 gm. of the salt from 100 ml. of water gave a product which reacted with yeast and sugar in the normal manner.

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Kinetic Measurements with the Pulfrich-Stufenphotometer

IF a chemical reaction takes place with change of colour, colorimetric measurements at time intervals form a convenient method for examining the kinetics of the reaction. It is possible to improve the older methods[1] based on this principle by the use of the Pulfrich-Stufenphotometer by Zeiss. This instrument permits of measurements: (1) at constant temperature; (2) for a large range of concentrations; (3)

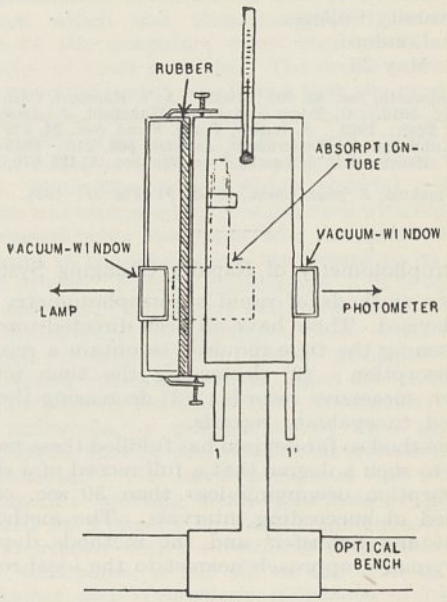

FIG. 1.

with monochromatic light; (4) in coloured and very volatile solvents.

Absorption tubes up to 4 cm. in length were kept in an air bath (Fig. 1). Those of greater length were surrounded by a water jacket (Fig. 2)[2]. It is easy to get constant temperatures ($\pm$ 0·05°) in the range 0°–80° by pumping water from a thermostat through 1–1′ and 2–2′ in Figs. 1 and 2.

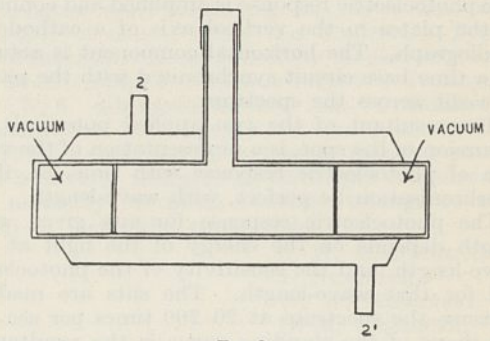

FIG. 2.

As the thickness of the absorption tubes can be varied from 0·1 to 100 cm., the range of concentrations in which measurements can be made is very wide, and it is also possible to work with both highly coloured and weakly coloured substances.

The *S*-filters of the instrument permit of measurements with approximately monochromatic light of wave-lengths 470, 500, 570, 610, 720 and 750 mμ.

The use of comparison absorption tubes containing the pure solvent automatically compensates for the colour of the solvent itself.

When volatile solvents were used or when measurements near the boiling point of the solvents were carried out, the absorption tubes were provided with double-ground stoppers[3].

The method just described was used to investigate the kinetics of a 1–4 addition to conjugate double-bonds (diene-synthesis) which will shortly be reported.

ALBERT WASSERMANN.

University College,
London.
May 26.

[1] A. Lapworth, *Soc.*, **83**, 995; 1903. A. V. Harcourt, *Phil. Trans.*, **212**, 187; 1913. G. Edgar and R. A. Wakefield, *J. Amer. Chem. Soc.*, **45**, 2242; 1923. A. Batley, *Trans. Farad. Soc.*, **24**, 438; 1928. cf. R. Kuhn and A. Wassermann, *Annalen*, **503**, 216; 1933.
[2] cf. V. Henri and H. de Laszlo, *Proc. Roy. Soc.*, A, **105**, 670 (Fig. 2); 1924.
[3] A. Smakula, *Z. phys. Chem.*, B, **25**, 94 (Fig. 3); 1934.

Spectrophotometry of Rapidly Changing Systems

MANY methods of rapid spectrophotometry have been devised. These have all been directed towards: (1) lessening the time required to obtain a record of the absorption; (2) decreasing the time interval between successive records; (3) decreasing the time required to evaluate records.

No method so far devised has fulfilled these requirements to such a degree that a full record of a change in absorption occupying less than 30 sec. can be obtained at succeeding intervals. The methods of Philpot and Schuster[1] and the methods described by Twyman[2,3] approach nearest to the ideal requirements.

By a simple application of the cathode ray oscillograph, we have been able to obtain a continuous representation of the absorption curve of a changing system, the time response being less than 1/50 sec. A series of slits are made to travel along the focal plane of a spectrometer. The slits are arranged at such intervals that the spectrum is always and only 'scanned' by one of the slits. As one slit leaves the spectrum, the next enters. The light traversing a slit is collected and falls on the cathode of a photocell. The photoelectric response is amplified and connected to the plates in the vertical axis of a cathode ray oscillograph. The horizontal component is actuated by a time base circuit synchronised with the passing of a slit across the spectrum.

The resultant of the two applied potentials, the excursion of the spot, is a representation of the variation of photoelectric response with time, or, if the synchronisation be perfect, with wave-length.

The photoelectric response for any given wave-length depends on the energy of the light at that wave-length, and the sensitivity of the photoelectric cell for that wave-length. The slits are made to traverse the spectrum at 20–200 times per sec. and the shape of the standing curve is the resultant of these two factors.

Should a solution placed before the collimating lens of the spectrometer possess an absorption band, a depression in the curve appears, corresponding to that portion of the spectrum absorbed. The wave-length of the absorbing region can be determined by means of a fine cursor wire which can be moved along the focal plane of the spectrometer by means of a scale calibrated in wave-lengths. The exceedingly sharp inflection on the curve caused by the shadow of the cursor wire can be moved to coincide with any required portion of the curve, and the wave-length read off from the scale. Any shift of the absorption band can be followed visually or cinematographically.

There are obvious difficulties in making the measurements of transmission quantitative. The wide variation of sensitivity of the photoelectric cell with wave-length and the distortion of the response by the amplifier are the chief difficulties, and it cannot be claimed that these have been overcome. The amplifier in use has a 4-stage resistance-capacity coupled circuit, designed to respond to frequencies from 100 to 10,000. It is probable that a wider range of response than this would be required to follow the steep intensity gradients of fine structure in some absorption bands. The principle is applicable to the ultra-violet or visible regions of the spectrum, though, so far, measurements have not been carried below the limit of transparency of glass.

E. R. HOLIDAY.
F. CAMPBELL SMITH.

Medical Unit and Hale Clinical Laboratories,
London Hospital, E.1.
June 6.

[1] Med. Res. Coun. Special Report Series, 177; 1933.
[2] *Trans. Opt. Soc. Lond.*, **33**, 9; 1931.
[3] *Proc. Phys. Soc. Lond.*, **45**, Pt. 1; 1933.

Electric Impedance of Suspensions of Yeast Cells

THE electric impedance of suspensions of yeast cells, suspended in solutions of electrolytes, has been measured as a resistance, R, and a parallel capacitance, C, with a Wheatstone bridge. In Fig. 1 are shown C and R, as functions of frequency, for a 63 per cent suspension of yeast cells in a 0·1 per cent sodium chloride solution. The form of the curve for C is interesting, particularly when it is compared

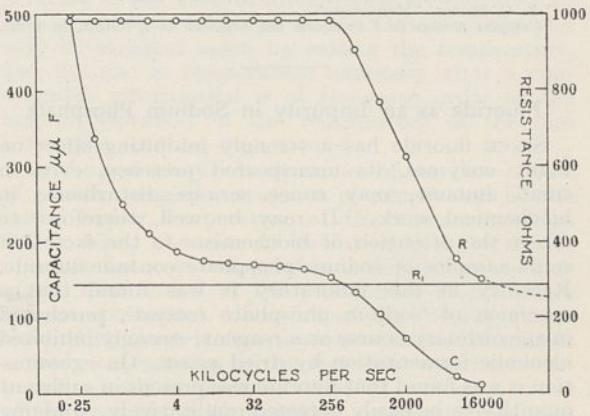

FIG. 1. Resistance (R), capacitance (C) and resistance of suspending fluid (R_1) for a 63 per cent suspension of yeast in 1 per cent sodium chloride*.

with the curve usually obtained for tissues[1], for it seems that it provides evidence regarding characteristics of the cell surface which may be obscured in the case of tissues by reason of their lack of homogeneity. For suspensions of red blood corpuscles, curves[1] have been obtained similar to those for yeast, although the increase of C at low frequencies is of much smaller magnitude.

Up to a frequency of about 128,000 cycles per second, the conductance of the yeast cell is very low compared with that of the suspending fluid. Over this range of frequencies, the impedance is derived from the surface of the cells (as well as from the suspending fluid) which acts as a complex impedance with a large capacitative component and a small phase angle. The drop in C and R at 128,000 cycles is considered to represent the point at which the impedance of the cell surface has been lowered sufficiently to allow an appreciable part of the current to pass into the cells. The nearly constant value of C at frequencies between 16,000 and 128,000 cycles is interesting. Within this range, C is also independent of the suspending fluid, as shown in Fig. 2, which shows C and R for 63 per cent suspensions of yeast in different concentrations of sodium chloride.

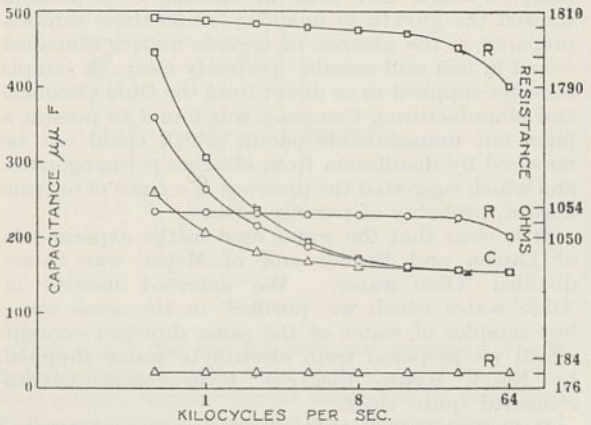

FIG. 2. Resistance (R) and capacitance (C) for 63 per cent suspensions of yeast in different concentrations of sodium chloride; R_1 is resistance of suspending fluid*.

□, 0·01 per cent sodium chloride, R_1 = 513 ohms.
○, 0·1 „ „ „ „ R_2 = 299 „
△, 1·0 „ „ „ „ R_3 = 53 „

* By the test of the electric conductance, the yeast cells are in equilibrium with 0·25 per cent sodium chloride. When the concentration of the suspending fluid is different from this, there is a slow change in the conductance of the suspending fluid.

In interpretation it may be assumed that, in this range of frequencies, the impedance at the surface of the yeast cell is derived from a poorly conducting membrane which acts as a static condenser. The increase of C and R at lower frequencies may be due to the polarisation of a slight conductance current through the membrane. Polarisation would be expected to occur if the permeability of the membrane were different for anions and for cations and the polarisation would be larger in the more dilute solutions.

The static capacitance per square centimetre of membrane can be calculated to be 0·6 μF at 16,000 cycles. Taking arbitrarily the dielectric constant of the membrane as 3, this capacitance would correspond to a thickness of 40×10^{-8} cm. This value is slightly larger than that found for the red blood corpuscle[2], although the difference scarcely exceeds the experimental error.

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[1] H. Fricke, Cold Spring Harbor Symposia on Quantitative Biology, **1**, 117; 1933.
[2] H. Fricke and S. Morse, *J. Gen. Physiol.*, **9**, 137; 1925.

Active Principle of the Amphibian Organisation Centre

IT has been shown (Waddington, Needham and Needham[1]) that the active principle of the amphibian organisation centre (the evocator) can be extracted with ether or petrol-ether from either larval or adult tissues. This has since been confirmed by Fischer and Wehmeier[2]. We have now proceeded some way with the purification of the crude extracts prepared from adult newts or calves' liver.

The fractions to be tested were emulsified in egg albumen which was then coagulated, and small lumps of the coagulum were implanted into the blastocœl of newt gastrulæ. The crude extract was first saponified and it was found that the unsaponifiable fraction, when implanted in the above manner, was capable of inducing neural tissue, either in the form of tubes or of large flat plates (palisade inductions). From the unsaponifiable material, a further fraction was separated by precipitation with digitonin, this reagent being then removed; the active material is present in the precipitate, and seems to be absent in the filtrate. Further purification is in progress.

Fischer and Wehmeier[3] obtained inductions by the implantation of glycogen, and claimed that glycogen is actually the active principle of the organisation centre. However, after the publication of Waddington, Needham and Needham's results, they undertook[2] a purification of their glycogen, and showed that it was possible to obtain inactive preparations. We have performed the converse experiment: starting with specimens of glycogen prepared by Pflüger's or Kerly's methods, we were able to extract active substances with ether. This shows that some, if not all, of the activity shown by Fischer and Wehmeier's specimens of glycogen is to be accounted for by the presence of impurities; and further, since the preparation of the glycogen involves boiling with alcoholic potash, it is also good evidence for the unsaponifiability of the evocator.

We have also made implantations of certain synthetic compounds belonging to the phenanthrene group, kindly supplied by Dr. J. W. Cook, of the Cancer Research Hospital. Most of the implants call forth only an undifferentiated cellular proliferation, like the sterols implanted last year (Needham, Waddington and Needham), but in a few cases, induction of neural tissue has occurred. Typical neural tubes have been induced by the two substances 9 : 10.dihydroxy-9 : 10.di-*n*-butyl-9 : 10.dihydro-1 : 2 : 5 : 6 dibenzanthracene and 1 : 9.dimethylphenanthrene. These are the first synthetic substances which have been shown to possess inducing powers. This behaviour seems to us additional evidence that the naturally occurring evocator belongs to some group of sterol-like compounds.

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[1] Waddington, C. H., Needham, J., and Needham, D. M., NATURE, **132**, 239, Aug. 12, 1933. Needham, J., Waddington, C. H., and Needham, D. M., *Proc. Roy. Soc.*, B, **114**, 393; 1934.
[2] Fischer, F. G., and Wehmeier, E., *Nachr. Ges. Wiss. Gött.*, VI, **9**, 394; 1933.
[3] Fischer, F. G., and Wehmeier, E., *Naturwiss.*, **21**, 518; 1933.

Phototropism in *Porcellana* Larvæ

VARIOUS explanations of the interesting phenomena classed as 'tropisms' have, from time to time, been put forward; ranging from Loeb's completely mechanical hypothesis[1] to the point of view of Russell[2], who maintains that what we see is the attempt of the animal to escape from an unusual situation; he calls this a 'flight response'.

Neither of these points of view is entirely satisfactory. It is not clear why the nature of a 'flight response' should vary with, say, the temperature, as it must in those cases where the sign of phototropism is changed by a slight rise in temperature; and, again, 'flight response' does not appear to fit in with Clarke's important work on *Daphnia*[3].

Loeb's theory of response to light which he called the "Muscle Tension Theory of Heliotropism" (*loc. cit.*, p. 54) has had to be modified in the light of work[3] which has shown that orientation is based on a mechanism entirely distinct from that of certain other aspects of phototropism. As a rule it is difficult to distinguish between (1) movement and (2) orientation, in respect to light; but the larvæ of *Porcellana* give a good example in which these processes are distinct.

The reactions of *Porcellana* larvæ to light have been described by Spooner[4]. He concluded that the behaviour of these larvæ was to be classed as 'photo-topotaxis', by which term he indicates a "special type of phototaxis in which the direction of movement is controlled by the direction of the light rays".

Spooner also observed that these *Porcellana* larvæ sometimes move backwards, instead of forwards, to the source of light. It has been shown elsewhere[5] that if a *Porcellana* larva is swimming normally towards the source of light and then the direction of light is suddenly reversed, the larva, instead of re-orientating itself to the new source of light, reverses its locomotory mechanism. This failure to re-orientate is correlated with the possession of the very long spines characteristic of these larvæ; for when these spines are cut off, the larvæ, on reversal of the direction of the stimulus, re-orientate immediately.

On Loeb's hypothesis the movements which resulted from stimulation by light were 'forced movements', the animal having no choice over its reactions: the predictable result being brought about mechanically. In the sense that *Porcellana* larvæ swim towards the light, the movements seen are 'forced'; but the evidence also shows that these movements are not mechanically produced as Loeb's theory holds, but that there is some nervous integration going on which determines the manner in which the response is to be produced.

Finally, it may be pointed out that to deny the presence of a psychological factor does not materially assist in a better understanding of this interesting form of behaviour.

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[1] Loeb, J., "Forced Movements, Tropisms, and Animal Conduct". Philadelphia and London. 1918.
[2] Russell, E. S., "The Behaviour of Animals". London. 1934.
[3] Clarke, G. L., *J. Exp. Biol.*, **9**, 180–211; 1932.
[4] Spooner, G. M., *J. Mar. Biol. Ass.*, N.S., **19**, No. 1, 385–438; 1933.
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Alleged Influence of Heavy Water on Mould Growth

LARSON and Barnes[1] suggest that water containing 0·5 per cent of diplogen exerts a stimulating influence on the growth of moulds. The conclusion is based on the results of experiments carried out partly by themselves and partly by S. L. Meyer[2] with *Aspergillus*. Work performed at this Institute casts grave doubt on the validity of their conclusions.

Eight samples of water (diplogen ratio varying from 1 : 8 to 1 : 700) prepared by a method involving contact with paraffin, and ten samples of water (diplogen ratio from the highest concentrations down to 1 : 800) prepared in the complete absence of organic matter, were repeatedly distilled from alkaline permanganate, and were then exposed to diffuse sunlight, in loosely corked test-tubes. All those samples which had been in contact with paraffin showed the growth of moulds; while those samples prepared in the absence of organic matter remained —and in fact still remain—perfectly clear. A sample of water supplied to us direct from the Ohio Chemical and Manufacturing Company was found to possess a faint but unmistakable odour, which could not be removed by distillation from alkaline permanganate, and which suggested the presence of a trace of organic matter, probably of paraffin nature.

It is clear that the water used in the experiments of Larson and Barnes and of Meyer was twice-distilled 'Ohio'-water. We detected moulds in 'Ohio'-water which we 'purified' in the same way; but samples of water of the same diplogen content which we prepared from electrolyte water supplied by Norsk Hydro Elektrisk Kvaelstofaktieselskab remained quite clear.

It is well known that many organic substances, including paraffins, provide favourable nourishment for the growth of moulds. In the light of the observations recorded here, it would appear more reasonable to attribute this growth to the presence of organic impurity rather than to any 'stimulating' effect of the heavy isotope.

The investigations are being continued.

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[1] NATURE, **133**, 873, June 9, 1934.
[2] *Science*, **79**, 210; 1934.

A Modification of the Gas Circulating Pump

OCCASIONALLY, while working with the Blackman-Bolas pump as modified by Leach[1], the apparatus ceases to work owing to the valve on the float side not functioning properly. All pumps, whether prepared in the laboratory or obtained from the manufacturers, behaved similarly, and their action was neither so uniform as one would desire it to be, nor could the rate of flow of air be regulated within sufficiently wide limits.

A circulating pump free from these defects is, therefore, desired. A special type of mercury valve has been devised to replace the float and valve arrangements of the Blackman-Bolas pump, and the pump so modified has been found quite satisfactory. The complete pump with the mercury valve is shown in the accompanying diagram (Fig. 1).

Enough mercury should be put in to reach a little above the tip of the inner narrow tube. This gives

short but rapid oscillations, and a uniform current of air is maintained, the rate of circulation being controlled either by regulating the suction, or varying the amount of mercury.

To ensure regularity of action, a bottle of about 250 c.c. capacity is connected between the circulating pump and the suction pump. The diameter of the lower exit of the valve should be about 2 mm.

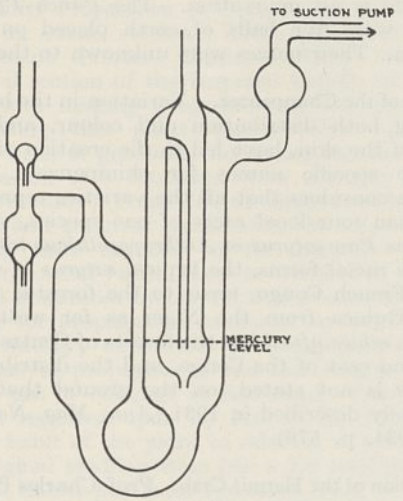

FIG. 1.

This pump has the following advantages: (1) It is one compact unit without any separate parts; (2) it gives a regular current which can be controlled within sufficiently wide limits; (3) once started, it is not liable accidentally to stop working.

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Andrew Crosse: Electrical Pioneer

IT is remarkable that the "Encyclopedia Britannica" makes only the merest mention in an article entitled "Electricity" of a man to whom Henry M. Noad dedicated his book "Lectures on Electricity" (George Knight and Sons, Foster Lane, London, 1844) in the following words:

"To Andrew Crosse, Esq., of Broomfield, near Taunton, Somersetshire, to whose indefatigable industry for a long period of years, electrical science is indebted for so rich an accumulation of valuable facts: the interesting results of whose electro-chemical researches have taught us the value of patient enquiry: and whose liberal, open, and communicative spirit is not less remarkable than his enthusiastic love of science."

Much of Crosse's work is outlined in "Memorials of Andrew Crosse" (Longman, Brown, Green, Longmans and Robert, London, 1857) by his widow Cornelia A. H. Crosse. This book also gives a detailed biography, and in it are many of the poems he wrote. On page 54 is a quotation from Singer's "Elements of Electricity and Electro-chemistry" (published in 1814), said to be the first printing of his name in connexion with science. Singer refers to Crosse as "a most active and intelligent electrician", and refers to his electrical exploration of the atmosphere with a copper wire originally a mile and a quarter long, later shortened to about 1,800 feet. With this and its associated apparatus, Crosse demonstrated the presence of positively, and of negatively, charged areas in thunder clouds, and suddenly located in a driving fog a huge 'pocket' of electricity which kept up between the separated terminals an "uninterrupted stream of explosions" lasting "for upwards of five hours".

Among the many things done by this comparatively little-known investigator may be mentioned the following: He treated the poor with his static electric machines "for paralysis and rheumatism, and in almost every case the effect was highly beneficial". He made extensive experiments on the effect of electrical currents on crystallisation and on the growth of plants. In 1816 he predicted "that by means of electrical agency we shall be able to communicate our thoughts instantaneously with the uttermost ends of the earth". He patented the extraction of metals from their ores by electricity, and also the electrical purification of water ("Memorials", p. 218, 221). "I have succeeded in dissolving *largely*, *pure* silver in distilled water, by electric action on a solid mass of it" (p. 237).

"The American Cyclopaedia" (D. Appleton and Co., New York and London, 1874) in an article on Crosse (vol. 5, p. 515) states: "As he worked alone and never published the results of his discoveries, they were unknown to the scientific world until the meeting of the British Association for the Advancement of Science in Bristol in 1836, when he was induced to explain them publicly. The announcement excited unusual interest, and Mr. Crosse was complimented by eminent scientific men."

Born on June 17, 1784, he died on July 6, 1855, in the room where he was born; and he is buried where his ancestors had been laid for more than two centuries. My attention was directed to Crosse and his work by Mr. W. L. Lemcke, of Franklin, Pa., who kindly loaned me the books on Crosse referred to above.

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Coastal Erosion of 'Coral Rock'

IN Lieut.-Col. R. B. Seymour Sewell's interesting article on "The John Murray Expedition to the Arabian Sea"[1], Fig. 1 pictures an undercut coastline of 'coral rock' at Chumbi Island, and this is said to have been "eroded and undercut by wave action".

In some apparently similar coastlines on islands in the Red Sea[2] I concluded that the undercutting was due to a combination of solution of the rock by sea-water and destruction by boring organisms, and certainly not to wave action. It would be of interest to know whether the detailed evidence from Chumbi Island does, or does not, agree with this.

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[1] NATURE, **133**, 669, May 5, 1934.
[2] *Geogr. J.*, **75**, 27–34; 1930.

Research Items

Jaina Temples. Two Jaina temples in the village of Tiruparuttikuṉram on the outskirts of Conjeevaram in the Deccan, described and fully illustrated in a monograph by T. N. Ramachandran (*Bull. Madras Government Museum*, N. S., 1, pt. 3), the larger, early Chola with a *maṇḍapa* in Vijayanagara style, the smaller in late Pallava style, supply an epitome of the main features of the chronological development of Dravidian temple architecture. Jainism, which was the most powerful religion in the south from very early times, is held to be the result of a partial attempt to Aryanise the Dravidian races. Conjeevaram has been identified with some certainty as Jina-Kāñchī, where a regular colony of Jains seems to have settled early. The larger Jaina temple here studied is the biggest in the taluk, and nowhere else is the style found in so concise and well-balanced a form. The chronological evidence afforded by style is supported by inscriptions, in which the larger temple is peculiarly rich. The ceilings and veranda are adorned with paintings illustrating Jaina mythology. The smaller temple, and the older, is dedicated to Chandraprabha, the eighth tīrthaṅkara, and the larger to Vardhamāna, the twenty-fourth tīrthaṅkara. Local tradition says that the two owe their existence to a Pallava king and that he built them at the instance of two Jaina teachers, who lived in the village. While the first part of the tradition is in accordance with the style of architecture, the latter part is evidently incorrect, as an inscription in the temple shows that the two teachers were not contemporaneous with the Pallavas, but flourished six centuries after them, that is, in the fourteenth century.

Animal Worship in Bengal. An account of an animal shrine and worship at Uttarbhag, Lower Bengal, by Dr. Sunder Lal Hora has recently been published (*J. and Proc. Asiatic Soc. Bengal*, N.S., **29**, No. 1). This desolate part of the Sundarbuns, dense jungle and infested with wild animals, is visited annually in October and May by a large number of people for wood-cutting and fishing. They practise a great variety of religious rites to propitiate the deities of jungle terror of all sorts. Uttarbhag is a small trading village, 23 miles to the south of Calcutta. In the month of February it was noted that some kind of *pūjā* had been practised at three different places in the village. The most conspicuous evidence of the ritual was a mud platform, on which were four images representing *Manasā*, the serpent goddess, *Makar*, the crocodile, *Dakshindar* or *Bŏn Bībī* and *Pānch-pīr*. Inquiry elicited the fact that the people had no conception of the godlings they worshipped. They referred the inquirer to the Brahmin who had performed the ceremony. The *pūjā* is performed jointly by Mohammedans and Hindus. The services of a Hindu priest are required for the worship of *Manasā* and *Makar* and of a Mohammedan, usually a *faqīr*, for that of the remaining two. The *faqīr* is said to have the power of driving away the harmful beasts of the jungle. It is significant that at Uttarbhag these five deities are worshipped at a single festival in January–February, instead of separately on the day of the year appropriate to each. In Bengal the worship of *Manasā* occupies a prominent place. At Uttarbhag she was represented by two conical mounds of mud, each mound having three clay heads of cobra arranged on one side and a mark in vermillion on the front. The crocodile was represented by a mud model. Of the four images of *Dakshindar*, two were said to represent the wife of Dakṣin Rāy. This wife is an innovation. The *Pānch Pīr*, 'Five Saints', were five balls of earth placed on a mud platform. Their names were unknown to the people.

Races of the Chimpanzee. Variation in the hair coat, affecting both distribution and colour, and in the colour of the skin, have led to the creation of unwarrantable specific names for chimpanzees. Ernst Schwarz considers that all the varieties represent no more than four local races of one species, variously known as *Pan satyrus* or *Anthropopithecus troglodytes*. Of these racial forms, the typical *satyrus* is confined to the French Congo, *verus* to the forested parts of Upper Guinea from the Niger as far west as the Gambia, *schweinfurthi* to the forests of Central Africa, north and east of the Congo, and the distribution of *paniscus* is not stated, on the ground that it was adequately described in 1931 (*Ann. Mag. Nat. Hist.*, June 1934, p. 576).

Evolution of the Hermit Crab. Prof. Charles Pérez has recently gathered together, in a short survey, the scattered information on the general biology of the commoner species of hermit crabs ; and by indicating the adaptations of type species arranges the Paguridea into an evolutionary sequence ("Les Pagures ou Bernards L'Ermite : un exemple d'adaptation". *Actualités Scientifiques et Industrielles*, **101** ; 1934). According to Prof. Pérez, the Decapoda in general show development from a primitive lobster-form to a more highly evolved crab-type. He suggests that though there is a lack of geological evidence, existing forms of Paguridea may be taken as indicating a line of evolution in the Decapoda which has gone through the hermit crab stage to arrive finally at the more advanced crab-type ; and has carried with it, in the structure of the adult and to a certain degree in the life-history of the individual, evidence of the route which it has taken. To the non-specialist, interested in natural history subjects, this paper should prove both interesting and instructive ; the serious zoologist already will be familiar with most of its contents.

Habits of the Corn-Bunting. In North Cornwall, where Lieut.-Col. and Mrs. B. H. Ryves have studied the corn-bunting (*Emberiza calandra*) intensively for two years, the species is undoubtedly double-brooded, although many hens are content with raising only one brood in the course of a season (*British Birds*, June 1934, p. 2). Three broods are probably a very rare occurrence. Such restricted breeding may be associated with the extent of the duties carried out by the female, for she alone is concerned in the building of the nest and in the incubating of the eggs, and almost alone she undertakes the rearing of the young, which on rare occasions may be fed by the male parent. Perhaps the devolution of work upon the female has encouraged also the habit of polygamy ; the twenty-four males observed during the season of 1933 had between them forty-five hens, and a total number of fifty-four nests, from which at least 126 young were safely reared. The nests of a breeding

group were sometimes close together, sometimes separated by distances up to 60 yards, but neither within the groups nor between the groups were there shown signs of territorial jealousy, although territories were well defined. In the first week of August, song diminishes in quantity, by mid-August the birds are silent, and by the end of August breeding territories are deserted.

Vegetative Propagation of Cacao. The third annual report on cacao research, 1933, published by the Government Printer, Trinidad, 1934, shows the botanical section of the Imperial College of Tropical Agriculture making progress with the problem of propagating this plant vegetatively. Extensive survey work is gradually achieving the first object, the location of a thousand trees suitable for more intensive study. Some 750 of these trees have been located and progress made with the next stage, of reducing their number to 100 suitable for more careful record of yield. These are then to be gradually reduced in number by careful field studies until types suitable for propagation as clones are available. In the meantime, experience is being gained of the technique of propagation, and fair results obtained by the use of cuttings in fine sand. One point of interest reported upon by Mr. E. E. Pyke is the branch habit of the plant in relation to propagation. The original seedling stem has a 3/8 phyllotaxis and a radial habit, but most branches have two ranked leaves and a plagiotropic habit. Obviously the first type has advantages for cutting propagation, and so it is desirable to study methods of stimulating the production of erect branches with radial habit. Cutting back the branch system, coupled with ring-barking, has proved very successful. It might be worth while, as in the case of apple stocks, to try the effect of cutting back coupled with earthing over the base of the branch shoots to stimulate root production before they are removed from the parent plant as isolated cuttings.

Gilled Fungi of Victoria. An article by Mr. J. H. Willis on "The Agaricaceæ or Gilled Fungi; Some Species common in Victoria" appears in the *Victorian Naturalist* (**50**, No. 18, 264, April 1934). Field study of the Agaricaceæ is in its infancy in Australia, but the paper under review provides a very useful introduction to the would-be student of outdoor mycology. A key for the determination of about seventy of the commoner species is given, and descriptions of each species appear. It is interesting to note that most of the species are such as are found in England, and the list would be a guide to our most common species here. The account is enriched with two coloured plates and numerous text figures. A very interesting fungus is "Blackfellow's Bread" (*Polyporus mylittæ*) which produces a large, dark sclerotium just below the surface of the soil. *Cordyceps Gunnii* and *C. gracilis*, two Ascomycetes, are also described, the former producing ascospores in threads emerging from the perithecia.

Plant Diseases in the Philippines. Trinidad Valley and the environs of Baguio are districts in the Philippine Islands where vegetable crops are grown intensively. Seeds and plants have been imported from other countries, and a considerable number of diseases have also made their appearance. These have been studied by Dr. T. G. Fajardo, who has published the results of his survey (*Phil. J. Sci.*, **53**, No. 1, 67, Jan. 1934). Diseases of the cabbage and other cruciferous crops, cucumber, chayote, pea, bean, egg-plant, pepper, potato, tomato, celery and other plants are described, and symptoms of several maladies are shown upon twenty-five excellent plates. Many of the diseases are well known in the British Isles—black rot of cabbage (*Phytomonas campestris*), bean rust (*Uromyces appendiculatus*), potato blight (*Phytophthora infestans*), potato scab (*Actinomyces scabies*) and several virus diseases. No specific methods for the control of each disease are given, but general methods of plant hygiene, spraying and the use of resistant varieties are set forth at the end of the paper.

Lower Cambrian Archæocyathinæ of South Australia. The Archæocyathinæ of South Australia were investigated very thoroughly by T. Griffith Taylor (1910). His work has now been supplemented by R. and W. R. Bedford in a paper on "New Species of Archæocyathinæ from the Lower Cambrian of Beltana" (*Mem. Kyancutta Mus.*, No. 1, pp. 1–7, pls. i–vi, 1934). These authors have obtained new material from the Ajax Mine in the Flinders Range, from which they describe and illustrate 32 new species and 8 new genera. Notwithstanding the excellent state of preservation of the Australian Archæocyathinæ, their systematic position is still a matter of uncertainty, and the present authors refrain from discussing this interesting question. These organisms have been variously referred to algæ, sponges, corals, or an independent group allied to Cœlenterates. Taylor was inclined to regard them as related to calcareous sponges, although some of their structures at any rate simulate those found in corals. A new genus, *Acanthocyathus*, may lend support to this view since it is claimed that the outer wall is formed of spicules. The Archæocyathinæ seem to have had a world-wide distribution in Cambrian times. Recently a considerable number of new forms have been described from Siberia by Vologidin.

Crustal Movements in South Africa. Evidence of recent rising in the coastal zones and warping of the interior of South Africa are discussed by Dr. A. L. du Toit in the *South African Geographical Journal* of December 1933. He points particularly to the eastern plain of Mozambique and the south and south-west coasts of the Cape Province. This uplift which affected the whole of South Africa was differential, and thus there were caused areas of depression or basins separated by ridges or axes of uplift. Such depressed areas are the Karroo-Basutoland, the Bushveld, Limpopo, Ngami, Ovampoland, Zambesi and other depressions. These have involved vertical movements of several thousand feet in places. The axes of the uplift and the longer axes of the depressions lie south-west and north-east or east-north-east, which suggests that they all owe their origin to the same tectonic causes. Dr. du Toit believes that these features mark a southerly expansion of the Central African rift system. The volcanic activity characteristic of the rift system is absent from the south, but occasional earthquake shocks are experienced there. It is suggested that there is evidence that these tectonic movements have persisted into the human period.

Fine Structure of Valve Characteristics. B. van der Pol and Th. J. Weijers have made an important investigation of the detailed structure of diode,

triode and tetrode characteristics (*Physica*, 1, No. 6, 481, April 1934). The experimental method consists in impressing a sinusoidal voltage on the steady grid potential and separating and measuring the harmonics in the anode current. It is shown that the amplitudes of the successive harmonics are, in general, proportional to the various differentials of the characteristic curve. (This is, however, not true at points of discontinuity.) The results show that the differential curves often indicate a large number of maxima and minima. They reveal that certain points on the characteristics may show a marked absence of detecting properties. In addition to this result of technical importance, the authors consider that their method may be of use in investigating such physical points as the critical potentials in secondary electron emission. They also discuss the use of the functions called Tchebycheff polynomials in the representation of valve characteristics.

Numerical Solution of Differential Equations. D. R. Hartree (*Mem. Manchester Lit. and Phil. Soc.*, **77**) has given a detailed description of a method of solving the differential equation :

$$\frac{d^2y}{dx^2} = f(x, y)$$

by numerical methods. This equation arises in Hartree's method of calculating self-consistent atomic fields, but it occurs very frequently in other branches of physics. The method given is applicable to equations involving functions specified by tables, in the absence of an analytical form. It is claimed that it is rapid and easy to apply. The method is self-checking, so that computing errors are apparent before they are deeply involved in subsequent work.

A Photoelectric Illumination Meter. Much interest has recently been taken in the new direct-reading photometers based on the use of photoelectric cells. The latest instruments of this type comprise only two essential parts, a photoelectric cell and a moving coil indicator. The cell is exposed to the illumination to be tested, the movement of the pointer being proportional to the intensity of the light. Photoelectric cells of the alkaline metal type have the drawback that a battery of constant E.M.F. is needed ; also the electrical output is so small that a highly sensitive instrument is necessary. The metal oxide type of cell, on the other hand, does not need a polarising battery, and the output is much greater. Thus a single selenium oxide cell suffices to operate a relatively robust instrument. In one recent type of apparatus, the Salford foot-candle meter, a cell $1\frac{3}{8}$ in. in diameter, is mounted in the hinged lid of the box containing the measuring instrument, the scale of which is graduated in foot-candles (50 ft.-c. giving the full-scale deflection). It is claimed that with such a photometer, most artificial lighting installations can be measured with sufficient accuracy. Under reasonable conditions, in the measurement of light from incandescent (filament) electric lamps, an accuracy of 2 per cent is stated to be possible. Fatigue is, however, set up by over-exposure of the cell to very bright light, and there is some degree of colour-error in the case of systems departing very widely from the normal daylight spectrum. Errors up to 30 per cent may, for example, be experienced with gaseous discharge lamps. A correction may be applied to obviate this difficulty which, however, does not arise in comparative measurements with the same type of source of light.

Interstellar Matter. The presence in interstellar space of widespread light-scattering material is now fairly generally accepted as the explanation of the well-known 'reddening effect' in the more distant stars. The question of the distribution of this light-scattering material is discussed by E. G. Williams in the *Astrophysical Journal*, vol. 79, p. 280. The diffuse matter giving rise to the 'stationary lines' of calcium has already been shown to be approximately uniformly distributed, and a comparison of the intensities of these interstellar lines with the colour excesses of stars is a useful method of judging the uniformity of the former (light-scattering) material. The author has measured the intensities of the interstellar [*K*] line in the spectra of 67 stars. The spectrophotometric method is described, and total absorptions are obtained with probable errors of about 5 per cent. These are compared with colour excesses obtained from three sources, which have been corrected on account of absorption by the Balmer lines of hydrogen. A statistical correlation is found between colour excess and interstellar [*K*] intensity, but the considerable dispersion indicates that the scattering matter is not co-extensive with the calcium. The bright-line stars form a group to themselves, and are all too red for their distances. This may have some bearing on Struve's theory of their origin, in which the extra reddening effect would be caused by an atmosphere of scattering matter ejected from rapidly rotating stars.

The Gas from Indian Oil Wells. Under the auspices of the Geological Survey of India in co-operation with leading oil companies, some interesting investigations of the oil-gas of Burma and Assam have recently been carried out. The results of these investigations are recorded in a paper by G. P. Kane, K. R. Krishnaswami and H. E. Watson (*J. Indian Inst. Sci.*, 17A, Part 3 ; 1934). The primary object of the undertaking was to assess the helium content of these gases, but complete analyses comprising carbon dioxide, carbon monoxide, oxygen, nitrogen, hydrogen, methane and propane contents were also effected. Throughout the investigations, special precautions were taken owing to the high methane content of the gases. This constituent is appreciably absorbed by alkaline pyrogallol, bromine and ammoniacal cuprous chloride, while with the higher hydrocarbons the tendency is even stronger. For this reason, the gases were submitted to fractionation before analysis. Tabulated results indicate quantities obtained by fractionation, amounts of the different gases present in each sample expressed as percentages on the dry gas, and helium content in parts per 100,000. Scrutiny of this table shows that the five samples from Burma were somewhat similar in composition, with the exception of one which had an abnormally high nitrogen content. One of the seven samples from Assam resembled the Burmese gases except for its high carbon dioxide content ; two were remarkable for their high nitrogen content and four for their low ratio of methane to other hydrocarbons. A natural gas from a seepage at Gogha, Bombay, was practically pure methane mixed with air. In all cases the amounts of helium determined were of the same order as in air, and in no case was the quantity sufficient for commercial extraction.

International Congress on Theoretical Physics at Kharkov

AN International Congress on Theoretical Physics was held at Kharkov on May 19–23 under the auspices of the Ukraine Physico-Technical Institute, and the chairmanship of L. Landau. At the official opening of the Congress, Prof. Niels Bohr, of Copenhagen, delivered a lecture on "Causality in Physics". Papers were read by E. J. Williams, E. Lifschitz, M. S. Plesset, V. A. Fock, L. Landau, I. Waller, J. Frenkel, M. Bronstein, J. Solomon, I. Tamm and L. Rosenfeld; and Niels Bohr joined in the discussions.

Williams described the general state of research on the scattering of hard γ-rays, and his recent experiments with thin scatterers. If sufficiently thin scatterers are used, the range of the electrons produced by the γ-rays is sufficient to enable them to escape from the foil and therefore to avoid annihilation except far away from the foil. In this way the annihilation radiation is separated from the other part of the radiation. It is found by this method that the annihilation radiation definitely exists and constitutes the whole of the scattered radiation of $0{\cdot}5 \times 10^6$ volts. From observations on the variation of the scattered intensity with the thickness of scatterer, an approximate estimate of the energy of the positive electrons may be made. The fraction of low energy positive electrons proves to be unexpectedly high, and may be explained by the production of double pairs. In the discussion, Frenkel suggested that the low energy of some positive electrons might be due to the production of pairs by a Compton effect. Gray and Tarrant's result that the energy of scattered radiation is practically equal to that of the absorbed incident radiation could be explained in the same way. Williams described a method of obtaining Heitler and Sauter's formula for the energy lost by an electron in radiative collisions with a nucleus. The perturbing field of the nucleus is analysed into harmonic components and the Klein-Nishina formula is applied to the scattering of the separate components.

In another paper, Williams described some evidence for the existence of the negatron, provided by observations of Kunze on cosmic rays. Kunze's Wilson chamber photographs seem to show that the high energy particles of cosmic radiation produce about 20 ions per cm. in normal air. If the particles were electrons, about thirty-five would be expected; if they were protons, twenty to twenty-five. As some of Kunze's tracks have a negative curvature, they may be due to negatrons.

Plesset discussed Dirac's theory of the positive electron and the developments made by Fock and by Carlson and Oppenheimer. The difficulties in these formulations connected with invariance was pointed out. Dirac's recent procedure is the only one so far which possesses the required invariant properties, but it is only approximate. The significance of the approximation was explained.

In another paper, Plesset described an application of quantum electrodynamics to the determination of the proper energy of a vacuum with the theory of filled negative energy states. Transitions are considered from the initial state of the vacuum distribution to intermediate states in which an electron-positron pair and a quantum of radiation are present; then transitions are considered from these intermediate states back to the initial state. The intermediate states may be given the picturesque interpretation of representing fluctuations in the vacuum distribution. If the summation over all intermediate states is performed, an expression is secured which represents the coupling of the initial state with itself by means of an effective self-interaction energy. This proper energy of the vacuum may be readily found to be infinite. An analogous calculation may be made for the case of the presence of an external field.

Lifschitz discussed the production of electronic pairs by a collision of two particles. The cross-section is calculated when the velocities are near to the velocity of light. For this case the particles may be assumed as moving rectilinearly without interaction and the effect is then due merely to the superposition of both fields. The calculation shows that the whole cross-section increases with the cube of the logarithm of the energy of the colliding particles.

Waller discussed the recoil of rays scattered by free electrons. It is well known that the theories based on point electrons do not make possible an adequate treatment of this problem. The appearance of infinities in the problem of the recoil of rays from bound electrons has been avoided by special devices (Dirac, Landau, Weisskopf, Wigner and others). In this way, analogies with classical theory have been obtained. The appearance of infinities in the problem of scattering by free electrons may be avoided in the calculation of the recoil (to the first approximation) by a simple device based on Dirac's theory of rays.

Fock described his mathematical developments of Dirac's theory of the positive electron. This work was published in Russia in 1933 and has not yet become sufficiently known. He explained that it simplifies the mathematics, but does not alter any of the physical difficulties in the theory; it has only made them more accessible.

Tamm discussed the deduction of exchange forces between neutrons and protons from Fermi's theory of β-radioactivity based on the assumption that transmutations of a neutron into a proton and vice versa are possible, and are accompanied by the birth or disappearance of an electron and a neutrino. Consider two heavy particles, a and b, a being in a neutron and b in a proton state. If a becomes a proton and b a neutron, the energy remains unchanged. Now those two degenerate states of the system may be linked by a two-step process—the emission of an electron and a neutrino by the neutron (a), becoming a proton, and the ensuing reabsorption of these light particles by the proton (b), becoming a neutron. The energy of the system is in general not concerned in the intermediate state. The emission and reabsorption of a positron and neutrino may also take place. In this way the two degenerate states of the system considered are split into two energy states differing by the sign of the exchange energy. Calculation shows that if the difference of masses of the neutron and of the proton is larger than the sum of the masses of an electron and a neutrino, the emission of light particles by a heavy particle may take place without a violation of the conservation of energy. But the corresponding value of the exchange energy may be shown to be far too

small. The negative result indicates that either the Fermi theory needs a substantial modification or that the origin of the forces between neutrons and protons does not lie, as would correspond to the original suggestion of Heisenberg, in their transmutations considered in detail by Fermi.

Rosenfeld described researches made in collaboration with Cambresier on dissociative equilibrium in stellar atmospheres. The number of molecules of a given kind in the atmosphere of a star can be calculated as a function of the effective temperature and surface gravity of the star on the assumption of dissociative equilibrium. In this computation it is essential to take into account the variation of pressure in the different layers of the atmosphere. The pressure at the base of the atmosphere may be calculated from the general absorption, by a method first used by Milne and Chandrasekhar. The treatment of concrete cases necessitates assumptions on the relative abundances of the atoms taking part in the reactions, but the results are quite insensitive to such assumptions. The equilibria of TiO, ZrO, and of the carbon combinations CN, CH, CO, C_2, have been computed in two different cases: when O is much more abundant than C, and vice versa. It is seen that the first case corresponds to the main sequence, the second to the branch of carbon stars, and that simply on this assumption a satisfactory agreement is obtained with the observed variations of intensity of the corresponding bands with spectral type and surface gravity (giant or dwarf character of the stars).

The members of the Congress had the opportunity of visiting many interesting institutions in Kharkov, Moscow and Leningrad. The laboratories of the Ukraine Physico-Technical Institute, and the Physical Institutes in Leningrad and Moscow were attractive, on account of the youthful enthusiasm of the staffs, besides the variety of the researches in progress. The Dzerzhinsky School for Orphans at Kharkov, organised and supported by personal subscriptions from the members of the G.P.U., contains four hundred boys and girls. They live with a large degree of self-government, and are trained in three magnificent factory-workshops, one of which is for the complete manufacture of cameras on the Leica model, including the lenses. A *kolkhoz* of three thousand acres supporting seven hundred persons was also very instructive. At the Kharkov Tractor Works, tractors of the McCormick type could be seen running off the assembling conveyor at the rate of 140 per day. In Moscow the constructive works of the underground railway were prominent. The members of the Congress will remember for a long time the interest of their visit and the hospitality of their hosts.

Aberdeen Meeting of the British Association

IN a previous article (NATURE, 133, 673, May 5), reference was made to the suitability of Aberdeen as a centre for excursions, and advantage has been taken of the city's position in this respect by the local committee for the Aberdeen meeting of the British Association to be held on September 5–12. Arrangements for excursions to places of historical interest through some of the most striking natural scenery in Scotland have now been completed. The Committee did not dare to hope that it could call upon the members of the Association to repeat the experience of its predecessors of nearly eighty years ago, where some of the excursions occupied the better part of two days. It has therefore arranged that the excursions taking place on the Saturday of the meeting will start at a comfortable time after breakfast and arrive back before dinner. The Committee has been fortunate in securing the services of authorities on the different areas and places of interest to be visited to write descriptive articles on the general excursions, and these articles will add to the enjoyment of these excursions. Arrangements have also been made for guides where necessary to accompany the members and to give information concerning the different places visited.

Probably the most interesting excursion for those who enjoy natural scenery is the Highland excursion. This starts at 9.20 a.m. by train through the cultivated parts of Aberdeenshire and Banffshire, thence into the valley of the Spey, which is followed, first westwards to Boat of Garten, then southwards to Aviemore where, looking eastward, there is a striking view of the Cairngorm range of mountains. Visitors should notice a V-shaped depression between Ben MacDhui and Braeriach, which marks the position of the highest mountain pass in Scotland—Lari Gghru. After leaving Aviemore, the train proceeds towards Inverness, passing Carr Bridge and Tomatin to Culloden Moor, where the members will leave the train and proceed by bus to the battlefield. There, local guides will join the party and give a short account of the battle and the objects of interest, including the famous Clava Cairns, on the Moor. The visitors will then proceed to Inverness, alighting on the Castle Hill. In Inverness they will be entertained by the Provost, Magistrates and Town Council to tea. After an interval, which can be utilised for seeing some of the places of interest in the city, the train will return from Inverness by the coast, from which there is a striking view of the mountains of Ross-shire, Sutherland and Caithness, the most prominent among these being probably the cone of Morven, which can be seen for a long way along the coast.

From a historical point of view, an interesting excursion is that which has been arranged to leave Aberdeen at 9.40 a.m. by train to Elgin, arriving there at noon. There, the members of the Association will be welcomed by the Lord Provost, Magistrates and Town Council of Elgin, and will be entertained to lunch. After lunch they will proceed by charabanc through the ancient province of Moray, which abounds in historical remains. The itinerary will be from Elgin Cathedral to Spynie Castle, Lossiemouth, Duffus Castle, Kinloss Abbey and Pluscarden Abbey. There will be an interval at Pluscarden Abbey, where tea will be provided near the ruins. Thereafter the party will return to Elgin, whence they will entrain for Aberdeen at 5.15 p.m., returning by a different route.

An excursion has also been arranged by motor-bus leaving Marischal College at 10 a.m., and proceeding along the North Deeside Road through the Pass of Ballater and Braemar to the Linn of Dee. On the return journey from the Linn of Dee, a halt will be made at Braemar for lunch. The party will

then return to Ballater, halting en route to view Crathie Church, then along the South Deeside Road through Pannanich and Glentanar, there being an interval for tea at some appropriate place.

Another charabanc excursion has been arranged which will take members of the Association partly along the Cairn O'Mount Road—the old main road from north to south. The starting time will be 10 a.m. from Marischal College, and from there the route lies along the south side of the Dee, thence along the valley of the Feugh to the Glen of Dye, over the Cairn O'Mount to Fettercairn and Edzell, where a halt will be made for lunch. On the return journey the route passes through Brechin and Stonehaven. Many places of historical and archæological interest are passed through on the way.

In addition to these all-day excursions, two half-day excursions have been arranged for the Saturday. The first of these leaves Marischal College at 1 p.m. by motor bus and proceeds by Castle Fraser and Monymusk, through 'Lord's Throat' to Alford, thence by Muir of Fowlis and Crossroads, Lumphanan to Tillylodge and Tarland. This excursion will return to Aberdeen about 7 p.m. The second of these excursions will leave Marischal College at 1.30 p.m. by charabanc. The itinerary is by way of Stonehaven, over the Slug Road to Banchory, on Deeside, thence to Potarch and Torphins, returning to Aberdeen at 6 p.m. This excursion is somewhat similar in interest to the preceding one.

Excursions have also been arranged by several sectional secretaries of the Association. These include visits to places of historical, archæological and geological interest, also visits to places typifying the various industries and activities of the area.

The meeting of the Association in Aberdeen has also provided an opportunity for commemorating the work of Prof. John Lamont, the Scottish astronomer and pioneer of modern terrestrial magnetism, who was born at Braemar in 1805 and was for many years director of the Royal Observatory of Munich, where he died in 1879. A sum of money has been raised to provide a monument which will be placed at Inverey near to his birthplace, and it has been arranged that the monument will be unveiled on the afternoon of Monday, September 10. A motor-bus will leave Marischal College on that date at 1.30 p.m., and will convey members of the Association who desire to be present at the unveiling of the memorial, which has been fixed for 4 p.m. approximately.

The Local Committee is confident that the members of the Association will show their appreciation of the arrangements made by taking full advantage of the opportunities offered.

William Froude and Experimental Tanks

THE summer meeting of the Institution of Naval Architects, which was held in London on June 10–13, was made the occasion of an International Conference on Experimental Tank Work. It was attended by delegates associated with experimental tanks in Great Britain and in Austria, France, Germany, Holland, Italy, Japan, Norway, Spain and the United States, and was notable for the many tributes paid to the work of William Froude (1810–1879) who may well be called the 'father' of the experimental tanks.

The proceedings were opened on June 10 in the hall of the Royal Society of Arts with an address by Lord Stonehaven, the president of the Institution, who said that many men of many nationalities have helped to elucidate those intriguing and often baffling problems which confront and sometimes perplex the ship designer, but there is one name which stands out above all others—that of the late William Froude, originator and pioneer of the experimental tank method of research.

Lord Stonehaven gave, in chronological order, a list of the principal tanks in the world and at the conclusion presented to the representatives of the tanks copies of Froude's portrait in bronze plaques which had been prepared for the occasion. Three papers were afterwards read, the first of these being by Sir Westcott Abell on "William Froude", while the second and third were respectively by General G. Rota of the Rome National Tank and Prof. T. B. Abell of the University of Liverpool.

Afterwards, during the proceedings, other papers were read, and there were a Government reception at Lancaster House, a dinner at Grosvenor House and various visits and excursions, including an inspection of the William Froude Laboratory at the National Physical Laboratory.

Froude's first model experiments were made in a large storage tank at the top of his house at Paignton, where he had gone to live in 1859. He removed to a new house, "Chelston Cross", at Cockington, Torquay, in 1867. Through the suggestion of Sir Edward Reed, the Admiralty agreed to pay for the construction of a tank according to Froude's design, and thus came into existence the pioneer Torquay tank, 278 ft. long, opened in 1874.

Nine years later, William Denny at Dumbarton built the first privately owned tank, and in 1886 the Admiralty built the naval tank at Haslar which was placed under the charge of Froude, who at his death was succeeded by his son R. E. Froude. The other tanks in Great Britain now are those of Messrs. John Brown and Co., Ltd., at Clydebank and Messrs. Vickers-Armstrong, Ltd., at St. Albans and the Yarrow tank, opened in 1911, and the new Government tank, 680 ft. long, both at Teddington. Of the last-named, opened by Mr. Baldwin in 1932, an account was given in NATURE of November 26, 1932, p. 800.

Of the tanks in foreign countries that at Spezia was opened in 1889, and that at Washington in 1898. These have been followed by others at Bremenhaven 1900, Charlottenberg 1902, Paris 1905, Hamburg 1908, Nagasaki 1908, Tokyo 1910, Vienna 1919, Rome 1929, and the tank at Wageningen, Holland 1933. The Nagasaki tank was destroyed in the earthquake of 1923, while the Hamburg tank is now one of a group of five belonging to the Hamburg Model Experimental Establishment. The tanks all differ in their dimensions, and their equipment includes all the refinements rendered possible by the advance of science; but the fundamental methods employed are based on those of Froude's. Tests are carried out on models of battleships, destroyers, liners, tramps and even fishing craft and dumb barges, and each tank is a centre of research.

Biochemistry and the Manufacture of Fine Chemicals

IN the Jubilee Memorial Lecture, 1933–1934, of the Society of Chemical Industry, delivered under the above title, Dr. F. H. Carr dealt chiefly with recent progress in the field of hormones and vitamins. In referring to the ill-defined boundary between biochemistry and organic chemistry, he classed as biochemical "those substances that exert dynamic properties in connexion with living processes and are directly concerned with chemical changes underlying physiological function". He characterised the technical production of insulin from the pancreas as one of the most important applications of biochemistry to the fine chemical industry, since countless human beings are kept alive by the use of this product. Insulin is a protein-like body of high molecular weight and unknown constitution, which enables the animal organism to deal with glucose; the total amount required daily by the human subject is about 5 mg. Only about 1 mg. per diem of thyreoglobulin, which occurs in the thyroid gland, is needed to promote the primary oxidative changes in the body. This complex protein owes its physiological properties to an iodine-containing derivative, thyroxine. The constitution of this substance is known, and it may be produced commercially at a cost lower than that of natural thyroxine. Adrenaline, another active hormone, which produces "all the vascular and visceral reactions accompanying the emotions of danger, excitement, and fright", has also been synthesised and subjected to successful large-scale manufacture.

Vitamin D (calciferol), of which about 0·05 mg. is required daily to promote the absorption of calcium and phosphate from the intestine into the blood, is formed when ultra-violet rays act upon ergosterol: "the pure vitamin can now be made and sold at such a price that our daily requirements cost less than one-tenth of a penny. Purchased as pure crystals, vitamin D now costs one-eighth its price in cod-liver oil". Vitamins A and D are fat-soluble substances found in the unsaponifiable fraction of certain fats. The recently synthesised vitamin C (ascorbic acid) is of a different type. It has been assigned the constitution 3-keto-*l*-gulonolactone, and is thus a remarkably simple substance having the formula $C_6H_8O_6$. It is the first vitamin to be completely synthesised by the methods of organic chemistry.

Dr. Carr remarks that there was something of a mystical element in Szent-Györgyi's discovery of ascorbic acid. Having isolated it from adrenal glands, he overcame great difficulties in obtaining it from various plant materials: thus, in 1928, from 5,000 oranges he was successful in preparing only a very minute quantity. One evening in 1932, at Szeged, his wife gave him pepper for supper. This was the big red Hungarian capsicum. He could not eat it, but was impelled with his whole household to extract vitamin C from it—"with the result that after three weeks of hard labour we had a full pound of the pure crystalline ascorbic acid". This sudden production in large quantity of a substance previously only seen in microscopic amount led directly to the final elucidation of its constitution and its synthesis.

Some Tunicates of the *Terra Nova* Expedition*

THE first portion of Prof. Garstang's long-promised account of the tunicates of the *Terra Nova* Expedition is now issued. This includes the Doliolida only, for each group is to be dealt with separately. It is not only a list and description of the species found, but also a critical monograph on the subject, containing valuable new views and a detailed survey of the work of previous writers, the whole being a helpful and important contribution to our knowledge of those pelagic tunicates which reproduce by budding and have 'nurse' stages.

No really new species are added but certain alterations in existing forms are made—one variety is raised to a species, a new genus is proposed, subgenera are raised to genera and the status of several species is reduced; the classification being completely revised. Every specimen has been examined, measured and recorded and the details summarised for each station separately. In the new classification proposed, the form and relations of the alimentary canal in gonozoid and phorozoid are taken as diagnostic; also prominent features in the diagnosis of most species are the myomeristic growth-limits set up by the muscular rings, which are shown to act as obstacles to the forward extension of the branchial septum and testis during the late stages of growth. These limits depend on the period of meroblastic adhesions between inner and outer membranes, which may be accelerated or retarded by outside conditions such as temperature and food supply. Thus it is thought that many pairs of so-called species are in reality no more than environmental modifications.

In the chief work, which has been a study of the variation of certain characters in the common species and an attempt to discriminate between different kinds of 'old nurse', the measurements of the muscle-bands have proved very useful, especially in the latter. A very interesting fact is the distinction to be found in the otolith which usually drops away after death in the 'old nurses' of two species of *Doliolina*, but rarely in the third.

It is taken for granted that the ancestors of the Thaliacea were sessile primitive ascidians with a tailed larva and a metamorphic life-history, and that, of existing Thaliacea, the doliolids constitute the group most highly adapted to an active pelagic existence. The evidence in support of this view has been clearly set out in the author's earlier papers.

The specimens from the *Terra Nova* Expedition come from four different areas—Atlantic, Pacific, Southern Ocean and McMurdo Sound. Three genera are recognised (the fourth *Dolioloides* in the present classification not being represented). These are *Doliolina*, *Dolioletta* and *Doliolum*, two species in the first, two in the second and one in the third. The single species from the antarctic region proper, the *D. resistabile* of Neumann, here called *Doliolum intermedium* var. *resistabile*, was actually taken within the antarctic circle, further south than any doliolid so far recorded.

* Report on the Tunicata. Part I. Doliolida. By Prof. Walter Garstang. British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. 4. No. 6. 1933. British Museum (Natural History).

University and Educational Intelligence

LEEDS.—Mr. E. R. Flint has been elected to the chair of clinical surgery in succession to the late Prof. Alfred Richardson. Mr. Flint will also retain the directorship of surgical research which he has held during recent months. Mr. H. W. Thompson has been appointed advisory entomologist on the staff of the Department of Agriculture. Mr. Thompson is at present on the advisory staff of University College, Cardiff.

LIVERPOOL.—At the meeting of Council on July 10 it was agreed to accept with regret the resignation of Prof. L. R. Wilberforce from the Lyon Jones chair of physics in the University, to take effect not later than September 30, 1935.

The following appointments have been made: Dr. A. M. Blackman, to the Brunner chair of Egyptology as from October 1, in succession to the late Prof. T. Eric Peet; Prof. D. B. Blacklock, Walter Myers professor of parasitology in the University since 1929 and formerly professor of tropical diseases of Africa, and director of the Sir Alfred Lewis Jones Research Laboratory, Sierra Leone, to the newly instituted chair of tropical hygiene as from October 1; Dr. T. Southwell, lecturer in helminthology in the Liverpool School of Tropical Medicine, to be lecturer in parasitology as from October 1.

The main University library is at present housed in the Tate Library, the gift of Sir Henry Tate in 1892. This present accommodation is altogether inadequate in view of the great increase in the library and the number of readers. Mr. Harold L. Cohen, of Liverpool, has therefore made a gift of £100,000 to the University for the erection of a new library. It is intended to erect the new library on the site of the old School of Architecture in Ashton Street.

LONDON.—The following appointments have been made:—Prof. H. E. Watson, professor of general chemistry at the Indian Institute of Science, to be Ramsay Memorial professor of chemical engineering (University College); Dr. A. B. Appleton, lecturer in anatomy in the University of Cambridge, to be professor of anatomy (St. Thomas's Hospital Medical School); Dr. S. P. Bedson, senior Freedom research fellow at the London Hospital, to be the Goldsmiths' Company's professor of bacteriology (London Hospital Medical School); Prof. F. R. Fraser, University professor of medicine at St. Bartholomew's Hospital Medical College, to be professor of medicine (British Postgraduate Medical School); Dr. James Young, lecturer in clinical obstetrics and gynæcology in the University of Edinburgh, to be professor of obstetrics and gynæcology (British Postgraduate Medical School); Prof. E. H. Kettle, since 1927 University professor of pathology at St. Bartholomew's Hospital Medical College, to be professor of pathology (British Postgraduate Medical School).

The title of emeritus professor of bacteriology in the University has been conferred on Prof. William Bulloch on his retirement from the Goldsmiths' Company's chair of bacteriology at the London Hospital Medical College, and that of emeritus professor of ethnology in the University on Prof. C. G. Seligman on his retirement from the University chair of ethnology at the London School of Economics.

The Council of East London College has recently conferred on Dr. Allan Ferguson the title of assistant professor in the Department of Physics.

"FRIENDS of the Hebrew University of Jerusalem" in London held their annual meeting on July 16. Since its dedication in April 1925, when it had no regular students but was composed of three research departments, the University has developed rapidly. Other research departments have been added and regular undergraduate instruction has been organised in a faculty of humanities and a division of biological studies, the former having now 253 students, including 21 graduates, and the latter 68. It has institutes and departments of Jewish studies, oriental studies, general humanities, mathematics, physics, biological and colloidal chemistry, inorganic and applied chemistry, Palestine natural history, parasitology and hygiene and bacteriology; a school of agriculture is projected for 1934–35 and the erection of a university hospital with a postgraduate school of medicine and hygiene are contemplated. Since the world economic depression set in, its annual income has shrunk from £50,000 to £40,000, but this has not prevented continued growth. It receives no grant to its regular budget from any public exchequer and the major part of its income is derived from annual contributions of which, hitherto, more than two thirds have come from the United States. The London friends have helped during the past year with donations of money and books and by making known the University's requirements, especially in connexion with German Jewish refugees. Nine displaced German professors have found refuge in the University. Glasgow, Liverpool and Manchester friends have all given valuable help, and a society of Palestine friends has lately been formed and has endowed a Bialik chair of Hebrew.

Science News a Century Ago

Darwin at Valparaiso

Under the date July 23, 1834, Darwin in his "Journal" says "the *Beagle* anchored late at night in the Bay of Valparaiso, the chief seaport of Chile. When morning came, everything appeared delightful. After Tierra del Fuego, the climate felt quite delicious—the atmosphere so dry and the heavens so clear and blue with the sun shining brightly, that all nature seemed sparkling with life. The view from the anchorage is very pretty. . . . In a north-easterly direction there are some fine glimpses of the Andes; but these mountains appear much grander when viewed from the neighbouring hills; the great distance at which they are situated, can then more readily be perceived. The volcano of Aconcagua is particularly magnificent. This huge and irregular conical mass has an elevation greater than that of Chimborazo; for, from measurements made by the officers in the *Beagle*, its height is no less than 23,000 feet. The Cordillera, however, viewed from this point, owe the greater part of their beauty to the atmosphere through which they are seen. When the sun was setting in the Pacific, it was admirable to watch how clearly their rugged outlines could be distinguished, yet how varied and how delicate were the shades of their colour."

Sturgeon on Electrical Kites

When William Sturgeon (1783–1850), the inventor of the electro-magnet, was living at Woolwich he used to experiment with kites and, through a startling

experience, on July 23, 1834 he addressed a letter to the Editor of the *Philosophical Magazine* entitled "Caution to Experimenters with the Electrical Kite". A day or two previously, when clouds had begun to gather, he had gone to the Artillery Barracks ground with an electric kite, got it afloat letting out string through his hands from a coil thrown on the ground. "When about a hundred yards of the string had been let out," he says, "a tremendous discharge took place, which gave me such a blow in the chest and leg that I became completely stunned, let go the string and consequently the kite soon fell." Sturgeon blamed himself for the accident, and after explaining the precautions which should be taken concluded "young persons who are fond of kite flying should also be cautious not to have their kites up during thunder storms, as it is possible that a wet string may transmit a violent discharge, from which a serious accident may occur."

Whewell on Inductive Science

When Whewell held the chair of mineralogy at Cambridge, he planned a series of treatises on the progress of knowledge. When considering the method of dealing with his subject, he corresponded with the political economist, the Rev. Richard Jones (1790–1855) and in a letter dated July 27, 1834, said : "You are to understand that I am to consist of three Books. Book I *History* of Inductive Science, namely, Astronomy, Mechanics, Physics, Chemistry and Botany historiographized in a new and philosophical manner. Book 2 *Philosophy* of Inductive Science, which is what I want to shew you. It will be dry and hard, I fear, as it must contain most of the metaphysical discussions which have been alluded to of late, but it must also contain all the analysis of the nature of Induction and the Rules of its exercise, including Bacon's suggestions. Book 3 *Prospects* of Inductive Science. The question of the possibility and method of Applying Inductive processes as illustrated in the philosophy of Book 2, to other than material sciences ; as philology, art, politics and morals."

Launch of H.M.S. *Pique*

On July 28, 1834, the *Times* recorded the launch at Plymouth of H.M. Frigate *Pique*, 36 guns. The surveyor, or chief constructor, of the Navy was then Captain (afterwards Admiral Sir William) Symonds (1782–1856) who had been appointed to the post in 1832 in succession to Sir Robert Seppings. The *Pique*, said the *Times*, was built upon the plan of Captain Symonds, "who has now, we believe, had the construction of ten ships of war upon his fundamental principles, as a naval architect—that great breadth imparts to a vessel greater stability, or a capability of sustaining an inclined force at the least angle of inclination. This position must be undoubtedly true ; but it is contended that its development has been carried to a degree of extravagance from which no desirable advantage whatever has been experienced, while the expense has been enormous. . . . The dimensions of the *Pique* are length of lower deck, 160 feet, breadth extreme 44 feet, depth of hold 13 feet 9 inches, tonnage 1,400 tons. She has been constructed under the able directions of Thomas Roberts, Esq., the veteran ship-builder of Plymouth dockyard, who has now completed the 50th man-of-war launched since his advancement to his present honourable rank."

Societies and Academies

LONDON

Mineralogical Society, June 7. C. PALACHE : The form relations of the lead oxychlorides, laurionite, paralaurionite, and fiedlerite. The separate identity of each of the first two minerals is confirmed and their homoeomorphism is exhibited by a re-orientation of laurionite. The form series of fiedlerite has been simplified by the choice of a new unit form. New forms are described on paralaurionite and fiedlerite. The crystallography of all three species is summarised in new angle-tables, and their habits are illustrated by a series of drawings. F. A. BANNISTER : The crystal structure and optical properties of matlockite (PbFCl) : W. Nieuwenkamp's recent work proving the identity of matlockite with artificial lead fluochloride, PbFCl, has been confirmed. New chemical analyses, X-ray work and optical measurements have been carried out on single crystals of matlockite from Cromford, Derbyshire. Single crystal photographs of the mineral have also confirmed the crystal structure proposed for artificial PbFCl. Artificial BiOCl, BiOBr and BiOI have crystal structures of the same type, and the relationship between matlockite and these and other compounds is discussed. Artificial Pb_2OCl_2 has a crystal structure quite different from that of matlockite. Mendipite, $Pb_3O_2Cl_2$, contains no fluorine, and it is improbable that fluorine has been overlooked in the oxychloride minerals from Laurium, Greece. V. ZSIVNY and L. ZOMBORY : Berthierite from Kisbánya, Carpathians. This rare mineral, previously known from two localities in old Hungary, is now described from a third, namely Kisbánya in comitat Szatmár (now Chiuzbaia in Satu Mare, Roumania) where it occurs as bundles of needles with stibnite and rhombohedral carbonates. Analysis agrees closely with the formula $FeS.Sb_2S_3$, but the specific gravity 4·65 is much higher than values previously recorded. L. J. SPENCER : Beryllium minerals (euclase and phenakite) from Africa. Apart from beryl, there are very few recorded occurrences of beryllium minerals in the whole of Africa. Euclase is described from pegmatite on the Lukangasi mica claim, Morogoro district, Tanganyika Territory. The main crystal on the single specimen collected measures 7·2 cm. by 3·5 cm., being much larger than any euclase crystal hitherto known. Seventeen crystal forms were determined. Small crystals of phenakite from pegmatite at the Klein Spitzkopje, South-West Africa, are of two distinct habits, prismatic and lenticular. A. C. SKERL and F. A. BANNISTER : Lusakite, a cobalt-bearing silicate from Northern Rhodesia. The mineral occurs embedded in quartz-magnetite-kyanite-rock of gneissoid appearance from 80 miles east of Lusaka. Crystals, generally tabular to (010) varying up to 5 mm. in length, are black in hand-specimens, but show a deep cobalt-blue colour, and strong pleochroism in thin section. The mean refractive index is approximately 1·74 and $2V$ is near 90°. Oscillation, Laue, and rotation photographs show that lusakite has an orthorhombic unit cell with edges a 7·86, b 16·62, c 5·63 A., and space-group V_h^{17}. The unit cell contains 8 $[RO.Al_2SiO_5]$ where R represents Fe, Co, Ni, Mg, Al, and H. The cobalt content is unique for a silicate and reaches 8½ per cent CoO, or nearly two atoms of cobalt per unit cell. It is almost identical in physical properties with staurolite, and X-ray photographs show that it possesses the same type of crystal structure. A. W. GROVES : The

determination of small amounts of copper in rocks. The paper describes the application to silicate analysis of the sodium diethyl-dithio-carbamate colorimetric method for copper. Data on the retention of copper by the ammonia precipitate are given. The method has a range of 0·001–0·25 per cent CuO when a sample of 2 grams is used. L. J. SPENCER: Thirteenth list of new mineral names. A dictionary list of 112 names collected from the literature of the past three years. Since the first list in 1897, a total of 1,918 names has been collected. L. J. SPENCER: A new meteoric stone from Silverton, New South Wales. A beautifully oriented stone weighing 351 grams was found by Mr. R. Bedford amongst debris in the old museum at Port Adelaide, which has recently been reorganised as a Nautical Museum. It probably dates from the time (1883) of the discovery of the rich mineral deposits at Broken Hill in the Silverton district. The stone is a white hypersthene-olivine-chondrite of the Baroti type with only little nickel-iron. M. H. HEY: Studies on the zeolites (8). A theory of the vapour-pressure of zeolites. An equation for the water vapour pressure of a zeolite (or other compound showing similar dissociation phenomena) is derived on simple kinetic grounds, and is shown to agree reasonably well with the available experimental data. The equation, which can only be a first approximation to the truth, is compared with other equations previously proposed. Kinetic treatment also leads to a reasonable equation for the rate of diffusion of water within a zeolite crystal. The condition of the water in the zeolites is discussed.

EDINBURGH

Royal Society, June 4. H. BRIGGS: (1) Graphical classification of carbonaceous minerals: the mineral oils. The graphical method adopted in previous papers relating to the evolution of carbonaceous minerals is extended to oils. The inclusion of mineral resins indicates their connexion with the heavy and light crude oils. The 'development lines' for the oils eventually merge with the coal belt at the stage of the lignites, thus supporting the view that coal and oil were derived from similar raw material, but by divergent courses of chemical evolution. Bischof's hypothesis to the effect that "the most dissimilar substances may be produced from ligneous fibre, according to the nature of the change" is thus revived. (2) Products of the natural development of coal and oil. The products of the maturing process, water, methane and carbon dioxide, are discharged in varying proportions during different stages of the evolution. Equations are constructed connecting the amount of these compounds, the slope of the 'development line' of the fuel, and the loss in weight during the transformation, with the percentages of oxygen at the beginning and end of the phase. Obtaining loss of weight from field and other sources, the equations are solved and the discharges of water, methane and carbon dioxide ascertained. The derivation of anthracite from semi-bituminous coal requires the consumption instead of the discharge of water. Also the generation of oil from vegetable matter involves the appearance of water on the left-hand side of the equation. MARY G. CALDER: Notes on the Kidston collection of fossil plant slides. (5) Structure of two Lower Carboniferous Lepidodendroid stems, one of the *Lepidophloios Wünschianus* type, and the other of the *Lepidodendron fuliginosum* type. The anatomy of two Scottish Carboniferous Limestone stems, labelled by Kidston as a new species "*Lepidodendron Langi*", is described. One stem, from Cadder, is referred to *Lepidophloios Wünschianus*, Carruthers sp.: the other, from Carluke, is referred to *Lepidodendron fuliginosum*, Williamson, and is discussed in relation to the British Carboniferous 'plant-break'. (6) Structure of two Lepidodendroid stems from the Carboniferous flora of Berwickshire. Two species of *Lepidodendron* from Calciferous Sandstone rocks in Berwickshire are discussed. One of them, to which Kidston had given the MS name of "*Lepidodendron Macconochiei*", is referred to *Lepidodendron brevifolium*, Williamson: and the other is referred to *Lepidodendron* sp. JESSIE A. R. WILSON: A new species of *Psygmophyllum* from the Upper Carboniferous of Scotland. A new species of *Psygmophyllum* from the Upper Carboniferous of Scotland is described and figured. The material upon which this new species is founded was discovered in Coal Measure shales exposed in the bank of the River Nethan, near Crossford, Lanarkshire, Scotland, and consists of two slabs of shale bearing four isolated leaf-impressions. These leaves measure about 5 cm. in length and show a single bifurcation of the lamina. This new species, the first record of a *Psygmophyllum* from the Carboniferous rocks of Scotland, has been named *Psygmophyllum scoticum*. J. S. HUNTER: The photoelectric thresholds of some turned metallic surfaces. Long wave-length photoelectric thresholds have been determined for the turned surfaces of the metals copper, silver, antimony, bismuth, tin, lead, nickel, iron, zinc, aluminium, brass and cast steel. These thresholds are found to be at 2985 A., 3200 A., 2996 A., 3075 A., 3000 A., 3060 A., 3125 A., 2980 A., 3225 A., 3740 A., 3025 A., and 2916 A. respectively. The photoelectric currents were measured by a valve electrometer circuit. The above thresholds are found to approximate to those for the same metals in the partially out-gassed state. It is concluded that a turned surface is one which is partially denuded of occluded gases. ROBERT SCHLAPP: Note on the electron configurations p^2s, p^4s. The secular equations for the energy-levels of these configurations, inclusive of orbit-spin interaction, are set up by treating the electrostatic exchange energy of two electrons as formally equivalent to a magnetic coupling between their spins (Dirac, Van Vleck). The equations are expressed in terms of three parameters, giving respectively the coupling between the equivalent electrons, the coupling between the s electron and the core, and the orbit-spin coupling. The g-values are found as functions of these parameters. The levels are compared with those observed in As I, agreement being reasonably good.

PARIS

Academy of Sciences, May 28 (*C.R.*, 198, 1889–1952). A. COTTON and TSAÏ BELLING: The magnetic double refraction of oxygen and nitrogen in the gaseous state and of aqueous solutions of chlorates. These experiments were carried out with the Bellevue magnet, with the addition of a supplementary coil. PIERRE WEISS: The variation of saturation magnetisation at low temperatures. The $T^{3/2}$ law. The T^2 law proposed by Weiss and Forrer expresses the experimental figures for iron and nickel down to 90° K., but below that temperature the $T^{3/2}$ law appears to agree better with the measurements. BERTRAND GAMBIER: Tetrahedra conjugated to a quadric Σ and to tangent edges of a quadric S. Tetrahedra of which the edges are tangent to two

quadrics S, S'. PIERRE BOOS: A characteristic property of surfaces of revolution. K. NIKOLSKY: The equation of the photon. ROBERT FORRER and MLLE. A. SERRES: A new magnetic phenomenon: increasing paramagnetism superposed on diamagnetism in alloys with a false Curie point. NICOLAS PERAKIS and LÉANDRE CAPATOS: The magneto-chemistry of rhenium. Metallic rhenium and hepta-valent rhenium. RENÉ AUDUBERT and JEAN ROULLEAU: The influence of polarisation on the effects of electrolytic selenium photocells. P. JACQUET: The adherence of electrolytic deposits of copper. M. GUILLOT and M. HAÏSSINSKY: The reduction of polonium in solution. A. MICHEL and G. CHAUDRON: The transformations of pyrrhotine and of ferrous sulphide. P. GOLDFINGER and L. SCHEEPERS: A micromethod for the determination of heavy water. The construction and mode of use of a float is described by means of which densities on 0·1–0·2 c.c. of liquid can be determined with an accuracy of one unit in the fifth place. JEAN BUREAU: The diagram sodium nitrite, water. The hydrate $NaNO_2 . 0{\cdot}5H_2O$. F. BOURION and MLLE. O. HUN: The determination of the total hydration of the ions of potassium bromide. A. BOUZAT and M. SCHMITT: The determination of azeotropic compositions. The azeotropes of benzene and cyclohexane. P. LAFFITTE and P. GRANDADAM: The direct oxidation of platinum under pressure. Platinum black, heated in oxygen under a pressure of 40 atmospheres, fixes the maximum proportion of oxygen at temperatures between 450° and 460° C. At higher pressures there are indications of the formation of mixtures of PtO and PtO_2: the latter has been isolated. B. BOGITCH: Some properties of silver silicate. The yellow colorations of glass produced by silver are probably due to the formation of silver silicates. R. DELAVAULT: The mechanism of the oxidation of magnesium alloys at a high temperature. When the magnesium contains ten per cent or less of foreign constituents, the oxidation of the heterogeneous metal starts through a liquid phase showing protuberances offering a large surface of contact with the air. OCTAVE BAILLY and JACQUES GAUMÉ: An unexpected mode of formation of the monoester of β-glycerophosphoric acid. RENÉ TRUCHET and JEAN CHAPRON: The Raman spectrum of conjugated double links in a nucleus. The Raman spectra of cyclopentadiene and dicyclopentadiene are given. Cyclopentadiene resembles furane, pyrrol and thiophene in giving a strong Raman line at 1400–1500 cm.$^{-1}$. From this it is concluded that the existence of the 1580 line for benzene furnishes no argument for rejecting the Kékulé formula. J. FLANDRIN and G. LUCAS: The age of the deposits with Medjanian facies of Djebel Morissane (Department of Constantine). NICOLAS THÉOBALD: The fossil insects of Kleinkembs (Pays de Bade). A study of about 1,000 specimens collected by Mieg and presented to the Basle Natural History Museum. ALPHONSE LABBÉ: The obscure penial gland of the Silicoderms. MME. LUCIE RANDOIN and MLLE. SUZANNE QUEUILLE: Can the evolution of A avitaminosis be influenced by the nature and proportions of the proteins of the basic regime? RENÉ HAZARD: Some physiological actions of sarothamnine and genisteine. W. KOPACZEWSKI: The rôle of the physical factors in the lacto-gelification of serum. MME. N. DOBROVOLSKAIA-ZAVADSKAIA and P. ZÉPHIROFF: A substance isolated from adenocarcinoma of the udder of mice, capable of activating the growth and advancing genital development in young rats.

Official Publications Received

GREAT BRITAIN AND IRELAND

British Non-Ferrous Metals Research Association. Fourteenth Annual Report and Notes on Researches in Progress for the Year ending December 31st, 1933. Pp. 48. (London.)

Department of Scientific and Industrial Research. Report of the Radio Research Board for the period 1st January 1932 to 30th September 1933. Pp. iv+137+4 plates. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

British Science Guild. The Annual Report of the Council of Management, 1933–1934, presented at the Annual General Meeting held at the Royal Society of Arts, London, on Tuesday, 12th June 1934. Pp. 31. (London.) 1*s*.

Papers of the Greenock Philosophical Society. Britain's Coal Problems: being the Watt Anniversary Lecture for 1934 delivered before the Society on 2nd March 1934. By Prof. William A. Bone. Pp. 30. (Greenock.)

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1933. Part 2. Pp. iv+108+8 plates. (London: H.M. Stationery Office.) 3*s*. net.

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation submitted to the Thirteenth Annual General Meeting on June 14th, 1934. Pp. ii+72. (London.)

The Royal Society for the Protection of Birds. Forty-third Annual Report, January 1st to December 31st, 1933; with Proceedings of Annual Meeting 1934. Pp. 54. (London.)

Joint Board of Research for Mental Disease: City and University of Birmingham. Annual Report, 1933–1934. Pp. 14. (Birmingham.)

Ministry of Agriculture and Fisheries. Guide to the Licensing of Bulls in England and Wales. Pp. 15. (London: Ministry of Agriculture and Fisheries.)

OTHER COUNTRIES

Bulletin of the Madras Government Museum. New Series, Genera Section, Vol. 1, Part 3: Tiruparuttikunram and its Temples, with Appendices on Jaina Units of Measurement and Time, Cosmology and Classification of Souls. By T. N. Ramachandran. Pp. ix+260+37 plates. (Madras: Government Press.) 11.4 rupees.

Commonwealth of Australia: Council for Scientific and Industrial Research. Catalogue of the Scientific and Technical Periodicals in the Libraries of Australia. Supplement 1928–1933. Edited by C. A. McCallum and D. W. I. Cannam. Pp. xx+453. (Melbourne: Council for Scientific and Industrial Research.) 5*s*.

Records of the Indian Museum. Vol. 36, Part 1: Notes on Fishes in the Indian Museum. 22: On a Collection of Fish from the S. Shan States and the Pegu Yomas, Burma. By Sunder Lal Hora and Dev Dev Mukerji. Pp. 123–138. (Calcutta.)

Memoirs of the Geological Survey of India. Vol. 64, Part 2: Asbestos in the Ceded Districts of the Madras Presidency, with Notes on its Occurrence in other Parts of India. By Dr. A. L. Coulson. Pp. vii+143–266+xx+plates 6–10. (Calcutta.) 3.8 rupees; 6*s*.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 79: The "Lucerne Flea" *Smynthurus viridis* L. (Collembola) in Australia. By Dr. J. Davidson. Pp. 66+5 plates. (Melbourne: Government Printer.)

Smithsonian Miscellaneous Collections. Vol. 89, No. 15: World Weather and Solar Activity. By H. Helm Clayton. (Publication 3245.) Pp. 52. Vol. 91, No. 2: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—New Mollusks of the Family Turritidæ. By Paul Bartsch. (Publication 3229.) Pp. 29+8 plates. Vol. 91, No. 12: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—Three New Amphipods. By Clarence R. Shoemaker. (Publication 3246.) Pp. 6. Vol. 91, No. 13: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—A New Genus of Brittlestars from Puerto Rico. By Austin H. Clark. (Publication 3248.) Pp. 3+1 plate. Vol. 91, No. 14: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—A New Starfish from Puerto Rico. By Austin H. Clark. (Publication 3249.) Pp. 3+1 plate. (Washington, D.C.: Smithsonian Institution.)

Union of South Africa: Department of Mines. Geological Series, Bulletin No. 1: The Witwatersrand System in the Klerksdorp-Ventersdorp Area; a Preliminary Report. By Dr. Louis T. Nel. Pp. 32+2 plates. 1*s*. Geological Series, Bulletin No. 2: The Andalusite Sands of the Western Transvaal. By F. C. Partridge. Pp. 16. 6*d*. (Pretoria: Government Printer.)

Bulletin of the Michigan College of Mining and Technology. New Series, Vol. 7, No. 3: General Information for the Year 1934–1935. Pp. 153. (Houghton, Mich.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 2, Part 10: Normenresttheorie galoisscher Zahlkörper mit Anwendungen auf Führer und Diskriminante abelscher Zahlkörper. Von Helmut Hasse. Pp. 477–498. 40 sen. Section 3: Botany. Vol. 4, Part 3: Anatomical Studies on some Leguminous Leaves with Special Reference to the Vascular System in Petioles and Rachises. By Shunji Watari. Pp. 225–365+plates 5–8. 2.90 yen. (Tokyo: Maruzen Co., Ltd.)

CATALOGUES

Africana: a Catalogue of Books, Maps and Pictures. (1934, No. 2.) Pp. 26. (London: Francis Edwards, Ltd.)

Catalogue de Livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 27.) Pp. 403–472. (Paris: Libr. Adrien-Maisonneuve.)

Photography as an Aid to Scientific Work. Pp. 8. (Ilford: Ilford, Ltd.)

B.D.H. Chlorotex Outfit for Determination of Free Chlorine in Swimming Pools and Drinking Water. Pp. 4. Acriflavine, Euflavine and Proflavine. Pp. 20. (London: The British Drug Houses, Ltd.)