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The Royal Commission on Safety in Mines

WHEN the King's Speech on the opening of Parliament on December 3 last stated that "the time has come when the existing provisions for the safety of workers in mines should be reviewed in the light of scientific knowledge", and that a Royal Commission would shortly be appointed "to inquire fully into this important matter", it might have been thought that it was intended to invoke the aid of science in such connexion. It therefore came as a shock to find that when, on December 18, the appointment of the promised Royal Commission was announced in Parliament, it contained no representative of science, but was composed of Lord Rockley (chairman), a county-court judge, the Chief Inspector of Mines, a former permanent Under-Secretary of State of the Home Office, a Labour M.P., the secretary of the Mineworkers' Federation, the president of the General Federation of Colliery Firemen's, Examiners' and Deputies' Association, and two colliery managers.

The terms of reference of the Commission are "to inquire whether the safety and health of mineworkers can be better ensured by extending or modifying the principles or general provisions of the Coal Mines Act, 1911, or the arrangement of the administration having regard to the changes that have taken place in organisation, methods of work and equipment since it became law, and the experience gained; and to make recommendations."

Although for many years past the death rate from accidents in mines in Great Britain (excluding *big* explosions of fire-damp or coal-dust) has been fairly constant between 0·87 and 1·11 per 1,000 persons employed, and British mines are among the safest in the world, much might still be done to reduce it. In a normal year, 'explosions', which in the popular mind loom largest among the perils of coal-mining, actually account for a minor proportion of the total deaths, the chief causes being 'falls of ground' and 'haulage accidents'. In exceptional years, however, like that of the great Senghenydd disaster (1913), 'explosions' may loom large in the death-dealing account; and it is of the utmost importance to safeguard the miner against them. Between 1920 and 1933 inclusive (omitting the great 'strike' years 1921 and 1926, and 1931, that of the Whitehaven explosion) the annual deaths from 'explosions' in British mines have been between 34 and 72 only, while those from 'falls of ground' have been between 454 and 607, and from 'haulage accidents' between 158 and 314.

Undoubtedly the miner's calling is beset with great danger to life and limb; and it is the duty of the State, and all concerned with mines, to ensure that all available resources of science are mobilised in his defence. The appointment of a Royal Commission, without a single representative of science on it, to review in the light of scientific knowledge existing provisions for the safety of workers in mines, is an anachronism calling for speedy remedy. Surely engineering science can yet do much to reduce the present excessive death-roll from 'falls of ground' and 'haulage and shaft accidents'; while, as regards 'explosions', the prevention of which is largely a physico-chemical problem, science should eventually (if not soon) be able so to localise any explosion that its spreading throughout the whole (or main) workings of a coal-mine should become a thing of the past, and extensive colliery explosions should then cease.

But even when science has done its all to minimise such perils, eternal vigilance will remain (as now) the prime condition of 'safety'; and the official inquiry into the recent Gresford disaster left an uneasy feeling that all is not as it should be.

Seeing that the Commission is charged with the duty of inquiring into the health, as well as the safety of mine-workers, the non-inclusion of any physiologist in its membership is to be severely criticised. The underground conditions of such hard and sustained manual work as miners have to perform call for greater scientific investigation and supervision than have yet been given to them; and there are many problems in sanitation and nutrition upon which only physiologists are competent to pass judgment.

Cultivation of the Unfit

LORD DAWSON OF PENN, like Sir Arthur Keith, is one of the few scientific men who have the rare courage of forcing the public to listen to unpopular truth. Just as Sir Arthur Keith has repeatedly pointed out that war is not due to a perversion of human nature but is the inevitable result of increasing population and race pressure and is the means by which Nature decides which race shall "inherit the earth", so Lord Dawson, in his recent address to the York Medical Society entitled "Medical Science and Social Progress", has—not for the first time—raised the question of whether our philanthropic efforts to save the lives of all babies, however weakly, may not serve as actual hindrances to the future well-being and progress of our race. Lord Dawson asserts that, in the sixty-four years between 1870 and 1934, the infant death-rate has sunk from 156 to 60 per thousand, and of children under five years of age from 68 to 18 per thousand. The population during this time has increased by about fifty per cent, and the fact that there has not been a more spectacular increase is solely due to the concomitant fall in the birth-rate.

Amongst the lower species of animals, we may, without serious error, assume that the birth-rate remains approximately constant; and the recurrent plagues of over-population are brought back to normal dimensions by the increase (1) in predatory animals, (2) in the incidence of disease. Only the most vigorous members of the species survive, and these are the worthy progenitors of the next generation. If this weeding out of the unfit is prevented, there follows a deterioration of the whole species. Two examples of this on a gigantic scale are sufficiently interesting to be recorded here. The first occurred in Switzerland: the second in New Zealand. The Swiss established a park for the preservation of the chamois, from which wolves were carefully excluded. As a result, more and more weakly and deformed specimens appeared amongst the stock until at last the Swiss introduced a certain proportion of wolves; these found in the weaker chamois an easy prey, and the surviving stock recovered its vigour and fine appearance. New Zealand has always been an ideal field for rearing mammals, because in it there are no indigenous predatory animals whatever. The Scottish settlers longed for the red deer of their native highlands, so these were introduced and let loose upon the New Zealand hills, where they flourished exceedingly. But soon the herds became polluted by misshapen specimens, and in the end wolves had to be imported to weed out the unfit.

Lord Dawson, therefore, poses the question: In adopting elaborate and costly social services in order to keep every baby alive, are we not preserving as progenitors of the next generation people who—morally, mentally, and physically—are just as unfit as the deformed chamois and deer? But our sentimentalists tell us that the population is increasing ever more slowly and will soon be stationary; so that there is no occasion for worry. But the birth-rate is falling, if we may so phrase it, at the wrong end. In the middle of the nineteenth century the commercial and professional classes had large families, and the numerous children of clergymen were proverbial. The minimum size of family required to maintain a population constant is four; for allowance has to be made for the sterility of some couples and the premature death of some children. The average size of family among both doctors and clergymen is now two, so that neither of these classes is maintaining itself by reproduction.

It would, however, be a libel to accuse the working-classes as a whole of over-breeding. When

the leaders of the skilled trades unions are bargaining with the employers for a 'living' wage they do so on the basis of the support of a man and his wife and three children—a most modest and reasonable demand. It is when we come to consider unskilled labour that we find reckless breeding still going on. Dock labourers and miners figure prominently in the over-production of children, and it is worthy of note that in both groups there is a large proportion of the Iberian element in our population from Wales and Ireland. But this level also receives social failures from the higher grades ; and these, according to Lord Dawson, include a large proportion of mental defectives—not of the extreme type, but just able to earn a living in the poorest paid occupation. These make most undesirable parents, and they propagate more defectives for the next generation. It costs, as Lord Dawson informs us, six times as much to care for and educate a mentally defective child as to educate a normal child in an elementary school, and when the task is complete the defective remains a defective.

How is this undesirable state of things to be remedied ? Lord Dawson gives two answers—first, by the spread of the knowledge of the means of birth-control and secondly by voluntary sterilisation. Knowledge of birth-control is spreading : the only objection is that it is used by the wise and prudent and ignored by the wicked and reckless, and it is the reproduction of this class that we wish to prevent. As to *voluntary* sterilisation, which is advocated by Lord Dawson, we do not share his confidence in this as a cure. Sterilisation is a mutilation to which few people will consent—in California it is imposed only by offering it as the alternative to perpetual imprisonment. Moreover, the tests for mental defect are by no means so reliable as Lord Dawson seems to suppose. Gross mental defect can, of course, be recognised, but the sufferers are unable to care for themselves and are confined in institutions. Where the line between a high-grade defective and a consummate fool is to be drawn no one can say.

There is only one remedy for the over-production of children that we can see, and it is very unpopular, so that it will probably be some time before the necessity for it forces itself on the public mind. This is compulsory sterilisation as a *punishment* for parents who have to resort to public assistance in order to support their children. Bishop Welldon recently mentioned the case of a worthless pair in Durham, both of the tramp class, whose only means of support was the dole and who had no less than seventeen children, and every time a new baby arrived the maternity benefit was spent on drink. What weight would prudential arguments in favour of sterilisation have in a case like this ? In the eighteenth century, as Miss Buer has shown, these surplus children were swept away by disease. In 1730, out of every five children born in London three died before attaining the age of five : now we carefully preserve all alive and in so doing we have prepared for ourselves a terrible problem which we or our successors will have to face. E. W. M.

The Astronomer Royal Surveys the Cosmos

Worlds Without End

By Dr. H. Spencer Jones. Pp. xv+262+32 plates. (London : English Universities Press, Ltd., 1935.) 5*s*. net.

THE Astronomer Royal has written an extremely readable account of the state of astronomical knowledge, in its broadest outlines, at the present day. This is a book intended for perusal by the general reader, to whom we recommend it with the utmost cordiality and confidence. A work of this kind must avoid the heavy technicalities of modern science if it is to be successful in providing pleasurable instruction and authoritative information to the reader for whom it is designed. The author has steered clear of pitfalls of this nature, and the result is a smoothly-written description of the fruits of astronomical investigations with, here and there, a pleasant excursion into the recent and remote history of the science.

The author's plan is to begin with a brief account of the earth and work outwards into space, finally reaching the spiral nebulæ—or "celestial catherine-wheels" as he calls them. In the final two chapters, the theoretical astronomer and the cosmogonist come into their own, and Dr. Spencer Jones gives in these pages an admirable résumé of the theoretical researches of Eddington and Jeans. As he says : "The theoretical astronomer uses the material which has been provided by observations ;

from what is seen he attempts to infer what is unseen, from the present to infer the past and the future".

The first five chapters deal with the earth, the planets, satellites, comets and meteors. In this section there is an account—which will be new to many well-versed in recent popular astronomical literature—of the fall, in a remote and almost uninhabited part of Siberia, of the most destructive meteorite of modern times. Although the fall occurred so far back as 1908, there was very little authentic information about the catastrophe it caused, until the U.S.S.R. Academy of Sciences sent an expedition a few years ago to make a thorough investigation of the district so grievously submitted to celestial violence. It is estimated that the total weight of the meteorite was 130 tons, and it brought devastation to an area of several hundred square miles. It is appalling to contemplate the wholesale destruction of life and property that would inevitably have been the consequences had it made its descent on a thickly populated part of the earth's surface.

The next six chapters take us over the familiar ground of stellar astronomy. In the section on "new stars" the Astronomer Royal concludes that whether we accept the moderately short time-scale imposed by the doctrine of the expansion of the cosmos, or the much longer time-scale demanded on other grounds, "every star passes through the nova stage at least once in its life-history". After mentioning that our own sun has not yet experienced the pangs associated with a nova outburst, he goes on to strike fear into our hearts by remarking that some astronomers believe that the sun is showing incipient signs of approaching the nova stage and then to reassure the timid that, even so, the outburst might not occur for some millions of years, an interval that is but a day in the life of a star.

In the last chapter the author discusses the possible fate of the universe and adds: "As a practical astronomer, I must emphasise that these are at present realms of speculation. Observation is the touchstone of every theory or hypothesis in science; the two alternative but divergent theories as to the future of the Universe cannot yet be tested by astronomical observations. Until this is possible, we are free to select whichever we prefer."

The book is attractively printed, and has a most generous allowance of photographic reproductions. Its modest price, the exceptional attractiveness with which it is written and the high professional standing of the author should all combine to make the book a deserved success.

Science and Anthropology

(1) Both Sides of Buka Passage: an Ethnographic Study of Social, Sexual and Economic Questions in the North-Western Solomon Islands. By Beatrice Blackwood. Pp. xxiii + 624 + 81 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 35*s*. net.

(2) Coral Gardens and their Magic: a Study of the Methods of Tilling the Soil and of Agricultural Rites in the Trobriand Islands. By Bronislaw Malinowski. Vol. 1: The Description of Gardening. Pp. xxxv + 500 + 116 plates. Vol. 2: The Language of Magic and Gardening. Pp. xxxii + 350. (London: George Allen and Unwin, Ltd., 1935.) 2 vols., 42*s*. net.

(1) ONE of the greatest misfortunes of anthropology is to have been set up as a school in imitation of old and tried sciences before it had proved itself sufficiently experienced and mature to take its place beside them. Having no discipline to offer, it has tempted those who dislike discipline. It is all the greater pleasure, therefore, to welcome a recruit imbued with the spirit of the older sciences.

Miss Blackwood has medical traditions. The effect is at once apparent in her work on Bougainville, the largest of the Solomon Islands. She has learned mental discipline and a subordination of personality to the subject. In technical parlance, she has objectivity. We must be all the more thankful as the facts are worth knowing. It is not that there is anything sensational about them (the sensational is rarely the most valuable): their value lies in their being presented with such thoroughness and integrity that they form a solid basis for theoretical construction. The book is a mine of facts presented in their proper setting as parts of a social system.

It is not for us to exploit this mine here. Every serious student of comparative sociology will have to work it himself, and to work it systematically. We may therefore more profitably use up our space suggesting how the next venture may be bettered; for it is devoutly to be hoped such a careful field-worker will not be allowed to rest on her laurels.

Language is the weak point of those connected with the physical side. They may, like Miss Blackwood, know the language well, but they are never philologists, which means that they are not trained in getting the utmost information out of words. Here and there Miss Blackwood does draw conclusions from words. The same expression is used of shell-money handed over in respect of a wife as in respect of goods: therefore a wife is bought. She may be right, but the analysis is not carried far enough to be decisive. By the same argument, Fijians buy their wives, since artefacts handed over at their weddings bear the same name as goods in a store. Yet nothing is more certain than that Fijians never bought or sold before the advent of the white man. They have only one word for dowry and goods, because formerly they knew only one class, ceremonial gifts. True, Miss Blackwood does not base her view on a word only, but on numerous discussions she has had with natives. Unfortunately, she does not relate those discussions; she tells us only the conviction they have left in her mind. Who knows what chance expressions have evaporated in the boiling down, small, but significant phrases such as one I cull from a New Caledonian tale: "This shell-money is the breath [that is, the life] of the child". To the New Caledonian, then, shell-money is more than a mere medium of exchange. What exactly it means to the Bougainvillian we cannot tell, since we have not got his words; but Miss Blackwood has told us enough to show that it does not mean the same as our money, since it is never used in barter, but is reserved for ritual occasions. The payment of bride-money cannot therefore be a purely commercial transaction (pp. 190, 192, 446ff., 457).

Miss Blackwood is content to sum up the replies to her inquiry into property. Her summary is that the rights of the land are vested in the chief. "Vested" is too vague, and besides it is not Melanesian. How the Bougainville people put it we are not told. Most, if not all, Melanesians would say "the land is his". But it remains to determine the exact meaning of "his"; it may convey a number of different relations to the land, which can only be determined by concrete cases. Not only can the same possessive have a wide range, but also Melanesian has several possessives each meaning a different relation. In Fiji it makes a difference whether the land is *nona* or *kena*. If it is *kena* it may not be his to own, but only tributary to him. These distinctions have been ignored in all works on the Pacific as being too small for notice; it is not the size of a detail that matters in science, but its significance. These possessives are as significant as our words copy-hold, freehold, usufruct, etc. Miss Blackwood is no doubt fully alive to these pitfalls, but she has not given us the means of satisfying ourselves that she is.

Miss Blackwood makes, on p. 265, a momentous statement that the good properties of leaves are carried into a liquid, momentous because the conception of transferable qualities plays a great role in the development of thought. Unfortunately, we do not know if Miss Blackwood is translating or paraphrasing, or merely inferring.

(2) Prof. Malinowski has a better appreciation of the value of *ipsissima verba*, for he is a linguist by nature, not by duty alone. It is largely in the character of a linguist that he now introduces us to the agriculture of the Trobriand Islands and to the connected ideas. On both counts he is to be congratulated, for agriculture has been strangely neglected by anthropologists. This is all the stranger since most of the peoples they talk about are wrapt up in agriculture. Still more neglected have been their thoughts about cultivation, plants, growth, life, reproduction. Yet a knowledge of these thoughts is essential to unravel the development of thought.

Unfortunately, our impatience to get to grips with these momentous facts is continually delayed by long sermons on method and on language in general. Why take us all the way to the Trobriands to tell us what is to be found at home? As the author says, "Everyone could convince himself from his own experience that language in our culture often returns to its pronouncedly pragmatic character"—in plain English, that speech is adapted to action. Then let us convince ourselves on our own language and save ourselves the long journey. Many of us will have already been convinced by such works as Paul's "Prinzipien der Sprachwissenschaft", and by all our masters used to tell us about translating, and will chafe at the delays in getting on with the really valuable accounts of a too neglected subject. These are supported by texts which give us peeps into native thought. Let us hope that Prof. Malinowski's prestige will cause his example of quoting the exact words to be widely followed, and thus help to lift anthropology out of its pre-scientific stage. Among the texts we would direct attention to No. 14, which definitely proves that the Trobrianders know pregnancy follows coitus (the author's distinction between "causation" and "necessary condition" will elude the plain man, and probably also the Trobriander).

Each text has a commentary which includes much of value; but one may doubt if Prof. Malinowski's "method of presentation" is the great improvement on "the usual glossary with texts and comments" which he proclaims it to be. The old style commentator cultivated the art of

conciseness. That is the very last art to be practised by Prof. Malinowski. He is too anxious to get every one of his ideas across to the reader. After very properly denouncing "the false conception of language as a means of transfusing ideas from the head of the speaker to that of the listener" (2, 9), he struggles through two volumes (not to speak of earlier ones) to transfuse into the reader every thought and experience he has had in the Trobriands and since. He regrets that he cannot "by a good phonographic record counterfeit the living voice of Tokulubulaki, how it trembled with emotion", and so on. When we want to push on with the facts of theoretical value, we are invited to linger on the central place and watch the events of public life. All this is excellent literature, but it is not science. Science is not photographic or phonographic, but schematic. It has to put all its facts on the table, but its facts are not each and every fact, but only the relevant ones, certainly not the tremor in Tokulubulaki's voice. We need not labour that point since Prof. Malinowski has done so himself in vol. 1, p. 317. Nevertheless, he will not spare us one detail of his experience or opinion.

We are overwhelmed as in the drawing-room of a brilliant but masterful hostess, who has invited us to meet a most interesting set of people, but so monopolises the conversation that we can scarcely get a word with the guests. Some of us may prefer less gifted, but more self-effacing, hostesses like Miss Blackwood. A. M. HOCART.

Voyage of the *Rattlesnake*

T. H. Huxley's Diary of the Voyage of H.M.S. *Rattlesnake*

Edited from the Unpublished MS. by Julian Huxley. Pp. viii+372+13 plates. (London: Chatto and Windus, 1935.) 15*s*. net.

THOMAS HENRY HUXLEY was above all else a great personality. He belongs to that small group of great men who exercised a profound influence over their contemporaries by the force of their courageous and outspoken characters. Those who follow after and whose heritage has been enriched by the words and actions of men of such calibre find in the details of their lives an interest which never fails.

We have been fortunate in possessing so admirable a biography as Leonard Huxley's "Life and Letters of Thomas Henry Huxley". But this book has one serious defect. Less than one twentieth is concerned with the first twenty-five years of Huxley's life, although the last four of these were of supreme importance. During that period he sailed around the world in H.M.S. *Rattlesnake*, visiting all the southern continents and accompanying pioneer cruises within the Great Barrier Reef of Australia and to the islands of the Torres Strait and of the Louisiade Archipelago, where he first acquired his interest in anthropology. While at sea, he conducted the researches on marine Hydrozoa and Tunicates which were to secure his election to the Royal Society at the unusually early age of twenty-five years. Last, but very far from least, he met Miss Henrietta Heathorn at Sydney, and in the result secured a lifetime of perfect married happiness.

During the voyage, young Huxley kept a diary. This passed into the possession of his son after the death of Mrs. Huxley in 1915, but was only discovered, hidden away among a group of old household account books, after the death of Dr. Leonard Huxley last year. It is now published under the editorship of Prof. Julian Huxley, and is revealed as a document of unusual interest.

The diary was not written for publication, and for that very reason gives a truer picture of the writer, while the inevitable discontinuities and omissions are amply made good by the editor. Prof. Julian Huxley has prefaced the book with a short account of his grandfather's life; in later chapters, interspersed between suitable sections of the diary, he discusses and amplifies their content. One most appropriate chapter includes extracts from the diary kept by Miss Heathorn after she met Huxley, while the last chapter contains entries from the diary kept by Huxley on the return voyage for the particular information of his future wife.

The diary constitutes a most revealing document. The young man, with what must appear to us now as a most inadequate training for his task, setting sail with a list of schemes for research involving fundamental investigations into every major group of the animal kingdom, from cœlenterates to fish, and gradually reducing this, as the limited opportunities, the tedium of the voyage, the enervating climate of the tropics and the inadequate accommodation on board exerted their cumulative effect, to a study of planktonic Hydrozoa, Tunicata and Mollusca. But it was just these animals, countless numbers of which could be collected on suitable

days in his tow-nets of ships' bunting, the transparent bodies of which permitted detailed examination in his cramped quarters on the *Rattlesnake*. He seems to have abandoned without fruitless lamentations such items of his research programme as proved impracticable.

Prof. Julian Huxley comments on the scanty references to corals, despite their appearance in the original list of problems. It is certainly disappointing that Huxley's voyage within the Great Barrier Reef, when the *Rattlesnake* visited a series of islands and reefs with an unsurpassed coral fauna, should have followed the first parting from his fiancée when he was clearly too despondent to take interest in anything. But the same lack of interest is displayed in the later cruise to the Louisiade Archipelago and the Torres Strait, where the reefs are equally prolific. It would appear that he realised that a study of these animals, as successful in Nature as they are retiring in captivity, was impossible. There is nothing more baffling than a contracted coral : we have Huxley's admission that he was not a collector, while he never had his imagination fired, as Darwin did, by the mystery of a coral atoll far from land.

It remains possible, however, that Huxley's experience of the teeming and infinitely varied life of the tropics, of coral reefs and rain forests, bore fruit in later life. Darwin and Wallace were led to a belief in evolution by the study of tropical life. When Huxley first read the "Origin of Species", the doctrines of which he was to proclaim throughout the civilised world, his mind must have gone back to his own experiences on board the *Rattlesnake*.

But the diary reveals the man rather than the scientific worker. One concludes the reading of it, with its record of enthusiasms and despondencies, hopes and fears, achievements and disappointments, with a much deeper knowledge of the character of the writer. Huxley left England in 1846, an obscure assistant surgeon ; he returned in 1850 with his scientific reputation established and his character formed. Only time separated him from the commanding position he later attained. It is idle to speculate to what he might have attained had he not sailed on the *Rattlesnake* ; it is certain that his years on that vessel were of supreme importance in determining the position he *did* attain.

The illustrations add greatly to the charm of the book. They consist in the main of reproductions of Huxley's own drawings, and reveal him as an artist of no mean skill. There is also a good map. The publishers are to be congratulated on the manner in which they have co-operated with the editor in producing an altogether delightful book.

C. M. YONGE.

Sociology

By Prof. Morris Ginsberg. (Home University Library of Modern Knowledge, No. 174.) Pp. 256. (London : Thornton Butterworth, Ltd., 1934.) 2*s.* 6*d.* net.

IN this, one of the latest volumes of an excellent series, Prof. Ginsberg has given us what is perhaps the most judicious existing conspectus of current sociological theory.

After discussing what are generally regarded as the two main attempts to delimit the field of his science, the author puts forward his own views. Sociology should provide a morphology or classification of forms of social relationships, especially in connexion with institutions and associations. It should define the relationship between differing institutionalised factors in social life (for example, moral and religious, moral and legal elements) and should determine—so far as it may—the fundamental conditions of social change and persistence. In carrying out this programme, "sociology must stand in friendly relations to such specialisms as history, comparative jurisprudence, anthropology . . . themselves within the social field, and to others more general, such as biology and psychology". Put in its broadest form, the object of sociology is to determine the relation of social facts to civilisation as a whole, involving a synthesis too vast for the special sciences.

At the present time, when, under the influence of politics, racial theory has become one of the dominating facts of life on the Continent, it is natural to turn to the chapters entitled "Race and Environment", and "Social Classes and Economic Organization". In the first of these chapters, the difficulties and pitfalls in seeking to link definite mental qualities with 'racial' (it would have been preferable to use the term 'ethnic' type) qualities are emphasised, and the conclusion reached that we are still in the anecdotal stage. The second chapter is a brilliant synthesis of the factors leading to the production of 'social classes' and the chances of rising in these. To some it will seem that Prof. Ginsberg magnifies the difficulty of 'passage', though even in America, as pointed out, the number of self-made men in the higher ranks of industry is decreasing.

To anthropologists and psychologists, this book will be of particular value as showing them how their disciplines are related to a larger whole.

Hutchinson's Technical and Scientific Encyclopaedia

Edited by C. F. Tweney and I. P. Shirshov. Vol. 3 : Hydrogen-Ion Concentration (continued) to Petrol. Pp. 1345–1920. 24*s.* Vol. 4 : Petrol Engines to Zymurgy, and Bibliography. Pp. 1921–2468. (London : Hutchinson and Co. (Publishers), Ltd., 1935.) 20*s.* ; 4 vols., £5.

WITH the publication of these two volumes, a praiseworthy piece of work is brought to completion. Among the subjects which receive particular consideration are hydrogenation, including hydrogenation of coal, indicators, internal combustion engines, iron and steel, lighting (the short note on lightning requires revision in the light of recent work and

results with the Boys' camera), locomotives, lubricants, metallography, silks (natural and artificial), sound (measurement, recording, reproduction, etc.), steam engines and turbines, television, thermionics, vitamins, as well as such departments of work as magnetism, navigation, telegraphy and telephony, and so on. Finally, there is a comprehensive bibliography containing classified lists of books and other sources of information on subjects of scientific and technical importance.

We have already consulted the Encyclopædia many times and it has usually responded satisfactorily to the inquiry. There is, however, no entry under "Positron", and though the title "Saccharimetry—See Polarimetry" appears in its alphabetical place, there is no entry under "Polarimetry", and we miss the description of either a saccharimeter or a polarimeter.

The particular value of a work of this kind is no doubt on the side of applied science, though some attention is given to biological subjects. Even an Encyclopædia of 2,500 pages and more than 25,000 titles cannot provide much more than first-aid information upon any scientific or technical subject, but this service is afforded in the work now completed. It will be a long time before any British editors or publishers plan or produce a better descriptive guide to the position and importance of most points in the very extended field of precise knowledge and its application to industry.

Things to Come

By H. G. Wells. A Film Story based on the Material contained in his History of the Future "The Shape of Things to Come". Pp. 142. (London: The Cresset Press, 1935.) 3*s*. 6*d*. net.

EVEN more vividly than in the argument of "The Shape of Things to Come", Mr. H. G. Wells depicts the swift downfall of modern civilisation and the rise of a new and scientific order of society. His adaptation to the writing of a novel of something of the technique of a film story enables him to emphasise the more forcefully the inevitableness of some such order of society as an alternative to war. Equally without unduly stressing the horrors of warfare, his dramatic technique may perhaps stimulate many to realise the dangers of the present situation on whom the logical analysis of Sir Norman Angell, for example, would be lost. The scientific worker may well find as much interest in the technique with which Mr. Wells develops his argument as in the picture he gives of an imaginary scientific age.

Even more pertinent, however, is the question which Mr. Wells inevitably raises in the mind of all. Must mankind pass through such a period of disaster and collapse, or is there still time to regain control and so organise the resources and powers which science has put into man's hands that the surplus energies of the race spend themselves upon constructive and creative art and science?

The pictorial technique adopted by Mr. Wells will prove more than justified if it can stimulate a forward look and a willingness to try new methods before catastrophe ensues in quarters which have hitherto been noted for mankind's direst peril—a belated mind.

Nouveau traité de psychologie

Par Prof. Georges Dumas. Tome 4: Les fonctions générales d'organisation. Les lois générales de l'activité mentale. Avec la collaboration de Prof. Ch. Blondel, Prof. E. Claparède, Prof. H. Delacroix, Prof. P. Janet, Prof. H. Piéron, Prof. G. Poyer, Prof. R. Revault d'Allones. Pp. vi+528. (Paris: Félix Alcan, 1934.) n.p.

THE fourth volume of this collective treatise possesses all the qualities of scholarship, clearness and accuracy which have distinguished this standard work from the beginning of its publication. It deals mainly with the general functions of organisation and mental activity, such as attention, memory, habit, association of ideas, schematisation, symbolisation and the physiological aspects of mental activity. The chapter on schematisation (pp. 161–264) contains a number of controversial points, such as the distinctions and relations between schematisation on one hand and concept, judgment and reasoning on the other. Those who are interested in mathematics and science in general would have liked to find a discussion of the process of symbolisation in those fields of knowledge. But perhaps Prof. Dumas has left over these questions for the next volume, which is to deal with the higher functions of the mind. We might also mention the excellent chapter on the psychology of sleep by Prof. Claparède, with the remark that this subject raises many more problems than can at present be answered. The practical value of this volume would have been greater if it had been provided with an index. T. G.

Unsolved Problems of Science

By A. W. Haslett. Pp. xi+317. (London: G. Bell and Sons, Ltd., 1935.) 7*s*. 6*d*. net.

A SERIES of articles in the *Morning Post*, of which the author is scientific correspondent, formed the idea for this book. It "was to be popular yet accurate; stimulating to the layman yet not without value to the scientist; emphasising the unknown, yet providing, incidentally, a reliable picture of what was already known". The author, while not expecting to reach this ideal, has in many places closely approached it. The style is distinctly journalistic; for example, Cockcroft and Walton are referred to as "the original large scale atom-splitters". A few of the statements are rather wild and might be a little misleading to the layman for whom the book is primarily intended; on p. 6, for example, we read, "Plasticene—was at one stage of very real importance in the exploration of the atom", surely a pointless statement since the same might be said of many other materials commonly employed in the apparatus. Then again, on p. 284, "The physicist has a long way to go yet before he will have satisfied his colleague the engineer that he knows what he is talking about," which is scarcely a happy way of expressing what the author evidently has in mind. Except for these occasional lapses, the book is enjoyable and worth reading, covering as it does the whole field of science in a representative way.

H. R. L.

Cosmic Rays and the Origin of Species*

By Dr. H. Hamshaw Thomas, M.B.E., F.R.S.

THE origin of species in Nature is still one of our greatest outstanding problems, and consequently any fresh information which seems to bear on the question is worthy of scrutiny. The object of this communication is to suggest a new direction in which inquiry may be useful. Our present knowledge seems to indicate that species in Nature are far more constant than they were formerly thought to be. Variation seems to depend on the regrouping of the different genes of the parents: it is limited by the combination possibilities of the genes and is less influenced by the environment. Hybridisation cannot be regarded as a sufficient explanation of the origin of new species unless accompanied by nuclear changes. But, on the other hand, there can be no doubt of the reality of mutations. *Spartina Townshendi* is a new species which has originated and spread under observation, and there is evidence which suggests that many other forms may have originated in a similar way in Nature. Among plants and insects raised in cultivation, many mutations have been recorded and studied. Thus while we have evidence of plant species existing over very long periods essentially unchanged, as we know from fossil and sub-fossil evidence, we also know that sudden change is possible. It is difficult to conceive that such changes are spontaneous; we must search for some external cause in the environment.

In a recent survey of the experimental production of mutations, N. W. Timoféeff-Ressovsky[1] has shown that treatment with short-wave radiations and high-speed electrons is so far the only effective method of inducing mutations giving constant and measurable results. All other treatments hitherto applied have led to no definite conclusions. At the same time, numerous investigations of the effect of X-rays on nuclear structure[2] seem to indicate that radiation may produce those cytological changes which are often associated with specific differences. There is thus no doubt that new forms can be produced by the action of penetrating rays and electrons on dividing cells[3].

But ever since Müller's sensational discovery of the effects of X-rays, there seemed to be little hope of showing that species arose in Nature through short-wave radiations or radioactive particles. Most investigators who have considered the question have held that the view "that the mutational process is in general caused by natural radiation is out of the question, as this does not amount to the quantitative values required to evoke mutants experimentally"[4]. No doubt this is true as regards the disintegration products of radioactive elements, but the recent discoveries of the nature and distribution of cosmic rays have considerably changed the situation.

We now know that photons and charged particles of very great energy are constantly reaching the earth in vast numbers. These particles closely resemble in their properties and effects the secondary corpuscular radiation produced by X-rays and the emanations from radioactive bodies, and there is no reason for supposing that their action on living nuclei would be different. The difference is, however, that while the X-rays in experimental conditions impinge in a dense and continuous beam on the chromosomes, the cosmic rays are generally in the form of a diffuse bombardment by single particles which are, of course, of infinitesimal size. Taking the ionisation as a measure of the activity of the stream of X-rays used in some experiments by Goodspeed and Olson[5] on *Nicotiana*, they would be more intense than cosmic rays at sea-level acting for the same time by a figure of the order of 5×10^7. Most of the doses used in radiation genetics have been 1,500 or more times greater. But we may notice that it seems certain that X-rays are effective through their secondary β-rays, for a correlation has been established by several workers between the ionisation and mutation rate curves, while mutations are also produced by radioactive substances and by cathode rays. There seems to be a threshold value for X-ray action. Small doses have been found to have an effect, while recent work on bacteria favours the view that a bacterium has a definite chance of being hit and killed by a single electron[6]. Thus, in view of what we know about the disintegrating power of high-speed particles, if a gene is a material body carried at a particular spot on a chromosome, it might well undergo structural change if struck by a single one of the high-energy particles originating from an X-ray beam, from a radioactive substance or from cosmic rays*.

While it is possible, as has been already suggested by Dixon[7], Hurst[8] and others, that cosmic rays

* Paper read before the Linnean Society of London on November 21.

* The physical basis of gene mutation has been considered by Timoféeff-Ressovsky, Zimmer and Delbrück, *Nach. Ges. Wiss. Göttingen*, VI, 1, p. 190 (1935).

may bring about nuclear changes and mutations, we need evidence that they do so.

Babcock and Collins observed the variation in cultures of *Drosophila* kept in a tunnel under 140 feet thickness of sandstone, which they assumed to be a screen from cosmic radiation. There was, however, more ionising radiation than in the laboratory where their controls were kept, and the mutation rate in the tunnel was significantly higher[9]. Another experiment[10] has been carried out with the object of ascertaining whether a colony of mice showed any significant difference in their variation when kept for a year at the bottom of a mine where they were effectively screened from cosmic rays. No significant difference was observed, and the conclusion was suggested that cosmic rays were ineffective in causing mutation. But these experiments scarcely dispose of the question, for though the number of rays which are recorded by a Geiger-Müller counter at sea-level appears considerable, the actual area struck by particles must be extremely small, and it may be years before a hit is made on a chromosome which is in a condition to show a subsequent effect and which gives rise to a visible change. Then it has also been found in X-ray experiments that the majority of the effects produced are lethal, some may be of an internal chemical nature, and only occasionally will a mutation arise showing external morphological change. We must also remember that in the plant world in Nature an exceedingly small fraction, perhaps one six thousandth, of the seed progeny of any individual survive. Consequently the chances of species originating through natural radiation would be small. If we are to find any noticeable results attributable to natural radiation, we must look in those localities in which the ionisation due to the energised particles is more intense.

Recent investigations by various workers[11] indicate that the ionisation due to cosmic rays falls off rapidly as they pass through the earth's atmosphere. The recent observations with balloons and aeroplanes[12] show that the ionisation rises more or less exponentially up to the highest point reached (62,000 ft.). At a height of 11,000 ft. the intensity of radiation increases about threefold and at 22,000 ft. the increase is about tenfold. At 62,000 ft. the ionisation is about eighty-three times greater than the sea-level value. The report in *The Times* of the recent ascent into the stratosphere from the United States mentions an increase of cosmic ray intensity by 150 times. Furthermore, the incoming radiation is not a uniform stream of similar charged particles, and its composition varies with altitude. From our point of view, the occurrence of what are called cosmic ray bursts and of showers[13] is interesting as they show bundles of ionising particles which, impinging on a mass of sporocytes, are likely to make direct hits on several chromosomes. Compton and Bennett[14] report that the frequency of these bursts is found to increase more rapidly with altitudes than does the intensity of the total cosmic ray beam. Prof. Compton has recorded bursts on Mount Evans (6,900 ft., lat. 50·58 N.) in which more than 3×10^8 ion pairs were liberated[15]. It may also be noticed that this ionisation is of the same magnitude as that said to have been produced by the X-rays used in experiments by Goodspeed and Olsen in which numerous mutations were produced in the tobacco plant[16].

These considerations suggest that if nuclear change and consequent mutation is produced by cosmic radiation, it will vary with altitude ; and while little mutation may be observable at sea-level, it should steadily increase with altitude. It may be noticed, however, that at high altitudes a latitude effect[12] has been observed in the intensity of ionisation, the values obtained increasing with the latitude from magnetic latitude 20° N. up to about 54° N. The readings made at 22,000 ft. in Panama (20° N.) and Peru (4° S.) are 29 per cent lower than those in California (41° N.) and 38 per cent lower than those in Spokane, Washington (54° N.). On the other hand, the height reached by plants growing on mountains falls steadily with increasing latitude.

It should be thus worth inquiry as to whether there is any correlation apparent between the variation of species and the intensity of cosmic radiation at different points on the earth. Some preliminary inquiries suggest that there may be evidence for such a correlation, and while a few examples may be mentioned, it is clear that the material needs careful collection and analysis before any certainty can be reached. In this quest plants should provide better evidence than animals, owing to the greater uniformity in their nutritional requirements. The distribution and occurrence of animals must depend on the distribution of their food, but the food substances of the plant are uniformly distributed over very wide areas. Plants also have infinitely less power of migration from their centre of origin.

Our inquiries may be made first among cultivated plants, and here some interesting information has been provided by Vavilov in the course of his studies on the geographical distribution of the varieties of important crop plants. Vavilov and his fellow workers[17,18] have studied the nature and distribution of the varieties of cultivated plants in different parts of the world. He found that in certain regions economic plants are represented by a great number of varieties, and deduced from this, as well as from the occurrence of allied wild forms, that their

cultivation originated in those areas. The presence of a large number of varieties was explained by the view that the plants have had a longer time in their original home in which to vary. Whether this is true or not, it seems clear from the information published that the areas in which the greatest specific and varietal diversity are found, are the mountain regions of the tropics and warm temperate regions, while the varieties in the lowlands are much less numerous even though extensive cultivation has been carried on, as in Egypt, for a very long period. Thus Vavilov found sixty varieties of *Triticum vulgare* in Afghanistan, fifty-two in Persia, forty-six in Baluchistan, while India has thirty-two, Mongolia thirty-one, and Italy twelve. In Afghanistan, fifty varieties of *Triticum compactum* were also found, and many of these wheat varieties were endemic. The *durum* group of wheats showed its greatest diversity in Abyssinia, where there are many more forms than in Egypt or North Africa.

By similar work, Vavilov distinguished seven or eight centres in which crop plants show such variety as to suggest that they may be considered as the foci of world agriculture; almost all these are on high mountains or plateaux, not more than 40° from the equator. In addition to Afghanistan and Abyssinia, the mountains of Central America from Chile to Mexico are very rich in varieties of maize, potatoes, beans, all of which are grown up to 12,000 ft. in Peru[19], cotton and fruit trees, as well as forms like the agaves and many of the ornamental plants of our gardens. Other centres are the southern ranges of Caucasus, the south-eastern Himalayas, Asia Minor and Portugal, together with a tract in western China not yet localised. In most of these areas cultivation has not, so far as we know, been very extensive compared with that in many lowland regions of the world, and if there was no external cause of variability at high altitudes one would expect the greatest number of variations to appear in the areas where crop production had been most extensive and the chances of mutation consequently greatest.

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(*To be continued.*)

Progress in Enzyme Chemistry*

THERE is once more definite progress in enzyme chemistry to report, largely due to the resumption of the study of enzymes from the purely chemical point of view. The appreciation on the Continent of the concept adumbrated by Willstätter that enzymes are composed of a colloid carrier, and of one or more specific active groups through which they are associated with or bound to the substrate on which they act, has opened the way for practical work which, inspired by the successful isolation by Sumner and by Northrop of highly active enzyme preparations in crystalline form, is affording some clues to their inner structure. Willstätter postulates the colloidal carrier as responsible for the catalytic activity and for the stability of the active group, which latter controls the specificity. Kraut has recently suggested the names *Agon* for the active group and *Pheron* for the carrier, which have been adopted by Oppenheimer in his books.

Willstätter's conception differs very little from that advanced by the Armstrongs so long ago as 1913, when the dual function of an enzyme in holding the hydrolyte and determining its hydrolysis was enunciated. According to them, the enzyme, which was a large colloid molecule with a particular, active centre, consisted of an acceptor together with an agent. The acceptor was

* This article is based upon (but much expanded) a paper read on September 6 by Prof. E. Waldschmidt-Leitz before Section B (Chemistry) at the Norwich meeting of the British Association.

compatible with the substance to be hydrolysed in such manner that a temporary attachment took place, whilst the agent was considered possibly to be a carboxyl or some other acid group of the colloid protein molecule. As this conclusion was based in the main on experimental work done with the enzymes which act as hydrolytic agents on carbohydrates, where the very highly specific nature of the enzyme in relation to the slightest change in structure of a glucoside is manifested, due consideration had to be given to the necessity for the structure of the acceptor corresponding in every detail with that of the hydrolyte, that is, it had to be something more than a combination of a single grouping in the enzyme with the substrate, such as suffices for the attachment of a peptide. Accordingly a glucose unit was pictured as an integral part of the enzyme.

Urease, pepsin, trypsin and chymotrypsin, an enzyme which coagulates milk, have been obtained as active crystalline preparations which are proteins having the greatest similarity to one another, so that Northrop is inclined to believe the enzymes to be only proteins.

Waldschmidt-Leitz, who is to-day the active worker of the Willstätter school, only admits the protein to be the carrier of the real prosthetic group, and points out that invertase preparations of equal activity, but of different composition, can be obtained by altering the manner of purification.

The crystalline active urease withstands tryptic digestion but loses activity when its protein is more profoundly hydrolysed by the combined action of pepsin and trypsin. Experimental work has made it possible to divide the peptidases which hydrolyse synthetic polypeptides, though they do not attach natural proteins, into carboxy- and amino-poly-peptidases, dipeptidases and imino-peptidase according to the structural characteristics of the peptides on which they act. The dipeptidase and the amino-poly-peptidase attach themselves to the free amino group of the peptide, so that the presence of such group in the substrate is an essential before hydrolysis takes place. If it is acylated the enzymes are inactive. The removal or alteration of the carboxyl group has no effect. The action of the enzyme in such instances is to split off that amino acid which originally carried the free amino group.

The carboxypolypeptidase unites with the carboxyl group and splits off that amino acid which carries this group in the free state. It is suggested by Euler in particular that the haptophore group of the aminopeptidase is an aldehyde or keto group which definitely anchors the peptide through the formation of a Schiff's base.

Following union of enzyme and substrate, there is decomposition into free enzyme and the hydrolysed products. This is also attributed to a definite atomic grouping, namely, the imino group as a second point of attachment. In this connexion Bergmann has produced evidence that the substitution of the imino-hydrogen even by a methyl group makes the peptide resist the enzyme: whereas glycyl-glycine is split, glycyl-sarcosine is unattacked.

It is suggested that all peptidases have in common the power of uniting with the imino group of a peptide, but they differ in regard to the other group with which they first combine.

This theory, termed the Two Affinities theory, allows enzyme action to be explained as an ordinary chemical reaction between definite chemical groups and gives precision to the original additive compound theory advanced by the Armstrongs.

A further example is afforded by protaminase; that from the pancreatic gland requires a free carboxyl group in the substrate and its action splits off free arginine from the carboxyl end of the molecule, whereas trypsin acts on the protamines by dissolving the linkages between two arginine residues in the middle of the peptide chain of a protamine, this enzyme requiring neither a free amino nor a carboxyl group at the end of the chain.

The view that certain, if not all, enzymes are proteins is strongly represented by the American school, especially Sumner and Northrop. The former claims that urease is a crystalline globulin, whilst the latter associates peptic activity completely with crystalline pepsin: both refute work of Waldschmidt-Leitz and others to the contrary. Crystalline trypsin may be inactivated reversibly, or irreversibly, the former being accompanied by the formation of reversibly denatured protein. Crystalline chymotrypsinogen and chymotrypsin have been isolated from the pancreas: the latter crystallises in plates which, after three recrystallisations, showed no change in proteolytic activity. Warburg's yellow oxidation enzyme has been purified to a stage when it can be split into pigment and protein: the two components are inactive but when they are brought together, the activity of the enzyme is restored. On the basis of these facts, Sumner (*Science*, 78, 335; 1933) considers that it is very unlikely there is any such thing as an enzyme carrier.

A recent discovery is the importance of the sulph-hydryl compounds such as reduced glutathione as activators in intracellular enzyme action. This is true both of proteolysis, for example, of papain and cathepsin, and also of arginase which brings about the hydrolysis of arginine into ornithine and urea. The co-operation of heavy metals like iron in the system appears to be helpful,

if not essential. It is believed from the work so far done with different sulph-hydryl heavy metal complexes that a dissociable compound of enzyme and activator is formed which has an increased affinity to the substrate. The alternative possibility that an active group in the enzyme itself is reduced is not favoured.

Strong evidence for the above theory is afforded by the specific co-glyoxalase action of glutathione, which has been recently followed quantitatively (NATURE, p. 645, October 19, 1935) by comparing lactic acid production with the amount of free —SH group as measured by iodine consumption. It is established that the glutathione first combines by means of this group with the substrate methyl glyoxal and then, as the reaction catalysed by the enzyme develops, enters into further changes which again involve its —SH group. In other words, the amount of free —SH group remains at a minimum during the reaction, but it all reappears when this is finished.

A second and quite different type of enzyme activation is produced by purely physical means. Certain substances which favour the splitting of fats and esters by animal lipase act through the production of colloidal particles which absorb both the enzyme and the substrate and facilitate the reaction between them.

It is established that the purified and recrystallised hæmoglobins of different animals, whilst containing identically the same hæmin, are made up of different globins. There is a quantitative difference between the peroxydase activity of such hæmoglobins of as much as 50 per cent under like conditions, which inasmuch as the active iron-porphyrin group is the same must be due to differences in the structure of the colloidal protein carrier.

It is clear that, for the moment, judgment between the rival carrier and protein theories must be suspended. The assumption of an active group or series of groups at the surface of the enzyme molecule, which definitely combines with the substrate in a normal chemical way, seems well founded. The subsequent hydrolysis of such addition compounds by other recognised groups in the enzyme molecule appears also to be highly probable : it is to be expected that experimental work, for which the way is indicated, will enable such groups to be identified. It remains to establish the structure of the groups in the enzyme which bring about its highly specific activity. This is especially desirable for the carbohydrases where the specificity is so fine ; it is to be expected that the progress now being made with the inquiry into the protein splitting enzymes will be continued among the carbohydrases. To-day, however, there is the added complication to face, namely, that the enzyme so often seems to require additional help from some other substance.

Earthquake-proof Buildings

By Dr. Charles Davison

ONCE more, the recent Quetta earthquake has emphasised the importance of erecting none but earthquake-proof buildings in a district subject to destructive shocks. The few houses in Quetta that could lay claim to such a title seem to have survived the earthquake unharmed, not even their chimneys having been thrown down.

How needless the loss of life may be was strikingly shown by Prof. Omori[1]. During the Mino-Owari earthquake of 1891, only 190 persons were killed in Nagoya, a city with a population of 165,000. In the earthquake of 1908, Omori estimated the number of lives lost in Messina as 75,000, the intensity of the shock being nearly the same in both cities. Taking the population of the Messina district as about equal to that of Nagoya, he thus concluded that, out of every thousand persons killed in Messina, 998 lost their lives needlessly, owing to the faulty construction of the houses. Omori's estimate of the number of deaths has been much reduced in later reports on the earthquake. But, even if we take the lowest figure of 25,450, given by Baratta, and the previous population as 90,000, the number 998 is only reduced by 2*.

The influence of site on intensity is shown in every earthquake. In the California earthquake of 1906, the distribution of damage was studied with unusual care in several districts, and especially by Mr. H. O. Wood in San Francisco[2]. The whole of the city lies between about one and nine miles on the north-east side of the San Andreas rift, and thus, if there were no variation in the site, the intensity should have decreased gradually from south-west to north-east. The areas of lowest intensity, in which a few chimneys fell, lay

* It should be remembered, however, that the Messina earthquake occurred at 5.20 a.m., and the Mino-Owari earthquake at 6.37 a.m., both local times.

in the central and south-eastern parts, and were always situated on hard rock exposed at the surface or covered by a thin layer of soil. The next degree of intensity, indicated by the general fall of chimneys and the fissuring of walls, marked the north-eastern portion, on the flanks of hills composed of hard rocks. Areas in which brickwork was seriously cracked and buildings occasionally fell, lay on the flanks of the hills facing the Pacific and in the valley floors in which the alluvial deposits are thick. The highest degree of intensity, marked by the shattering of masonry blocks of good construction, occurred as a rule only on 'made land' in small ravines or lagoons, one area of exceptionally great destruction lying at the north-east corner of the peninsula. Thus, the safest sites are those of level hard rock, and the worst are those of 'made land' filling up former creeks ; though, even on the latter, well-constructed houses have been known to escape serious injury.

Prof. Milne, in an admirable series of papers[3], urged that the foundations of all buildings should be deeply laid. During his residence in Japan, he made some interesting comparisons of the motion of the ground during an earthquake at the surface and bottom of a pit 10 ft. deep. The experiments were continued by Sekiya and Omori[4], and showed that, in severe earthquakes, the ripples superposed on the large undulations were smoothed away at the bottom of the pit. Thus, Milne suggested that buildings should rise freely from deep foundations. On the other hand, in Japan, a rigid foundation of reinforced concrete has been used, strongly tied together, in the form of a deep solid mat. In Tokyo, buildings on such foundations on soft compact soil were found to withstand shocks better than those with pile foundations.

An entirely different foundation is that recently devised by Mr. R. W. de Montalk[5]. It consists of a slab of reinforced concrete fixed to the ground. A raised rim of the same material contains a layer of shingle a few inches deep, and on this rests a slab of reinforced concrete, the foundation proper of the building. The method is still in an experimental stage, but it is worth noticing that, fifty years earlier, a similar foundation, consisting of quarter-inch iron shot, was used by Prof. Milne in Japan. The small house erected by him stood firmly against storms of wind, and, during a moderately strong earthquake, was practically unmoved.

In plan, buildings should be rectangular and as nearly square as possible, and L or E or U shaped outlines should be avoided. The walls should be uniform in height, without towers or heavy cornices, and they should be braced diagonally. Roofs must always be light, and, above all, the joists of floors and roofs should penetrate at least two-thirds, if not the whole, of the thickness of the walls. The heavy losses at Messina in 1908 were largely due to the neglect of this precaution. In many houses, the roofs and floors fell, while the main walls were left standing.

As to the material to be used, few earthquakes have thrown so much light as the great Japanese earthquake of 1923. Mr. H. M. Hadley[6] spent two months in examining many hundreds of buildings in the ruined cities. The fundamental characteristic of earthquake-proof construction, he concludes, is rigidity of structure. Whatever the material, the undamaged building was one so braced that it moved bodily as a block or unit with its foundations. At the time of the earthquake there were sixteen large steel-framed buildings in Tokyo. Six of these were absolutely undamaged ; the others were more or less severely injured. In the former, the common feature was the complete or extensive use of reinforced concrete walls, that stiffened and braced the frames. In the latter, other materials were used that failed to give this support. Of the buildings composed of reinforced concrete in Tokyo, it was found that only 1·3 per cent entirely collapsed, while 78·0 per cent were uninjured. Wooden buildings, the most numerous of all at that time in Tokyo, were undamaged when adequately braced ; otherwise, they collapsed ; but all suffered greatly from the fires that broke out afterwards. In the reconstructed Tokyo and Yokohama, buildings of every kind are limited in height to 100 ft., and houses of wood or brick to 42 ft.

One other point on which this earthquake has thrown useful light is the effect of the period of oscillation of the buildings. A little more than a year earlier, Prof. Omori investigated the periods of five typical buildings in Tokyo. They ranged from 0·50 sec. to 0·65 sec. After the earthquake, it was found that the building with the shortest period was undamaged and that, as a rule, the amount of damage increased with the period. In great earthquakes, most of the destruction is caused by oscillations with a period of between 1 sec. and 1·5 sec., and thus Japanese architects endeavour to design their buildings so that the period shall not be much in excess of half a second.

Unfortunately, to raise a building that will withstand an acceleration of 0·3 g, or even half this amount, is a costly work. Steel-framed buildings should, of course, be used in all Government offices, in great hotels, and in the principal streets of a city. But, in the smaller houses—the houses that determine whether or no a great earthquake shall be costly to human life—such a

form is unattainable. Much, however, can be done by attention to a few points. So far as possible, the bricks and mortar used should be of good quality, and the mortar should be of nearly the same strength as the material that it binds. The safest building is one of a single story, but if, to economise ground space, two or more stories are essential, then the joists should penetrate the walls. Lastly, the thickness of the walls should diminish upwards. The ideal cross-section, as Mr. N. Nasu points out in his interesting report on the Bihar earthquake[7], should be one bounded by parabolic arcs with the vertices downwards. In the seismological observatory at Tokyo, the walls are of brick and so shaped. During the earthquake of 1923, not a fissure appeared in its walls, whereas inside the observatory, a brick column, 15 ft. high and 3 ft. square in section, was fractured and the upper part twisted through an angle of 30°.

According to the Delhi correspondent of *The Times* (December 24, 1935), the Government of India has decided that the official Quetta shall be rebuilt so far as possible on the existing site, and that earthquake-proof buildings should be provided for the permanent employees of the Government living there. On account of the strategic importance of Quetta, it is necessary that the military garrison should remain there in about the same strength as before, and desirable that the headquarters of the civil administration should also be placed there. Though it is recognised that, for many years to come, Quetta will probably be free from destructive earthquakes, it has also been decided that, if the civil population wish to return to the city, they must be prepared to adopt a safer and more expensive standard of building.

[1] *Bull. Imp. Earthq. Inv. Com.*, **3**, 39–40 (1909).
[2] A. C. Lawson, "The California Earthquake of April 18, 1906", **1**, 220–242, 335–346 (1908).
[3] "Construction in Earthquake Countries", *Trans. Japan Seis. Soc.*, **14**, 1–246 (1890). The experience gained in recent earthquakes, especially in that of Japan in 1923, is embodied in Mr. J. R. Freeman's valuable work, "Earthquake Damage and Earthquake Insurance" (New York, pp. 904 (1932).)
[4] *Trans. Japan Seis. Soc.*, **16**, 19–45 (1892).
[5] NATURE, **130**, 41–42 (1934).
[6] *Bull. Amer. Seis. Soc.*, **14**, 6–8 (1924).
[7] *Bull. Earthq. Res. Inst.*, **13**, 417–432 (1935).

Obituary

Sir Alfred Sharpe, K.C.M.G., C.B.

FORTY years ago, when exploration in Central Africa was beginning to give place to settlement, pioneers of many nations frequented the rooms of the Royal Geographical Society in Savile Row and passed within the sphere of hospitality of Sir John Keltie at his club or his home. There one was in the habit of meeting Sir John Kirk and the Rev. Horace Waller, friends of Livingstone, F. C. Selous the hunter-settler in Matabele Land, H. H. Johnston the artist-administrator of British Central Africa, O'Neill the typical exploring consul, and many more. Of these Sir Alfred Sharpe was, until a few weeks ago, almost the last survivor, and his passing ends a period in which science was enriched by men of adventurous spirit, keen even if unspecialised observing power, honesty of purpose and a determined aversion from every form of spectacular publicity.

Alfred Sharpe was born in Lancaster on May 19, 1852, trained to the law and at thirty-three years of age became a stipendiary magistrate in Fiji. In 1887 he found a wider sphere in a consular post in the Shire Highlands east of Lake Nyasa. At that time, Scottish missionaries were establishing stations on the Lake, and the Moir brothers, working in association with them, were opening up honest trade. Arab slave raiders were a perpetual danger both to the natives and to the pioneers, and Sharpe found himself in a congenial atmosphere, hunting the big game and fighting the slave-traders under the direction of Sir Harry Johnston. He was a man of unbounded courage, and danger, whether from man or beast or from natural difficulties of any kind, was a piquant incentive to his work. He had the responsibility of extending British influence to the westward of Lake Nyasa and thus laid the foundations of Northern Rhodesia.

Sharpe succeeded Sir Harry Johnston as Commissioner and later as Governor of British Central Africa, which he left in 1910 as perhaps the best organised and most prosperous tropical colony in Africa. He was a great hunter, and his shooting expeditions added many new species to zoology. He encouraged all branches of scientific work and took an understanding interest in the researches of naturalists.

On laying down his official duties, Sir Alfred Sharpe continued to make journeys of exploration in other parts of Africa, especially in the northern section of the Great Rift Valley on the east and in the almost unknown interior of Liberia on the west. He published the results of his geographical studies in an important work, "The Backbone of Africa", in 1921. His mind, vigorous to the end, was constantly at work on problems associated with his geographical achievements, and it is understood that in the last week of his life he completed a paper for publication. He was struck down by sudden illness when on the eve of embarking for a Christmas holiday in a milder climate. His death took place at the age of eighty-three years on December 10. H. R. M.

Prof. J. Schetelig

JAKOB SCHETELIG, professor of mineralogy and geology in the University of Oslo, died on October 17, 1935, after several years of ill-health.

Schetelig started his scientific career as assistant to Fridtjof Nansen in working out the oceanographical results of the first *Fram* expedition. Later, for a short period, he acted as assistant in the Physical Institute of the University of Oslo. In 1905, under the inspiring influence of Prof. W. C. Brögger, he transferred to the Mineralogical Institute; and in 1917 succeeded Brögger as professor and director of the Mineralogical and Geological Museum.

Prof. Schetelig published work on the moraines of the Oslo Fjord, but most of his researches were connected with petrology and tectonics. He produced many papers on the mineralogy of Norwegian pegmatites, especially from the extreme south of Norway (Setesdal), and described a new silicate of scandium, thorveitite. He also suggested the possibility that certain granites of north-western southern Norway, generally regarded as Archæan, might be of Caledonian age. His greatest achievements are connected with the Oslo region. When Schetelig took up geology, Brögger was just preparing a new set of geological maps, which would indicate the distribution of the main types of igneous rocks described in his classical monographs of the 'eighties. Schetelig entered into this task with great enthusiasm and energy. In the last two decades, a large number of geological maps on the scale of 1 : 100,000 have been published by Brögger and Schetelig in collaboration; and in 1923 a general map on the scale of 1 : 250,000 appeared. This latter was highly appreciated by the sixty members of the Geologists' Association who in 1934 spent ten days in the region.

While tracing the igneous outcrops, Schetelig was struck by the circular outline, not only of many plutonic bodies, but also of lava fields, which evidently had been subject to subsidence. He was the first in Norway to connect these features with the cauldron-subsidence theory, so clearly demonstrated by Scottish geologists in the classic areas of Glen Coe and Ben Nevis. In this way he initiated comparative studies between Norwegian and British magmatic phenomena, of general interest and full of promise for the future.

Prof. Schetelig was an outstanding figure in geology, who will be missed by friends and colleagues in many countries. OLAF HOLTEDAHL.

C. H. B. Quennell

THE death of Mr. Charles Henry Bourne Quennell, which took place on December 5 at the age of sixty-three years, cannot be allowed to pass without reference in NATURE. By profession an architect—he served on the council of the Royal Institute of British Architects in 1912–15—he was the author in collaboration with his wife, formerly Miss Marjorie Courtney, the painter, of a series of books for children and young people, which have been widely adopted in schools, and by the excellence of their text and illustration have strongly stimulated interest in the cultural background of the more formal study of history. In this field, the authors were not indeed the pioneers, but by their thorough and scholarly methods, their detailed acquaintance with the archæological data, as well as their judgment in selection and presentation of the material both in text and illustration, they achieved a well-deserved success. Their best-known series deals with 'every-day things' in the old and new stone ages, the bronze and iron ages, Roman Britain, and the Anglo-Saxon, Viking and Norman periods.

Radó de Kövesligethy

A BRIEF account of the life and work of this well-known seismologist by Prof. B. Simon appears in the last number of the *Bollettino* of the Italian Seismological Society (**33**, 200–205 (1935)). He was born on September 1, 1862, at Verona, at that time under Austro-Hungarian dominion, both his parents being Hungarians. He spent the years 1881–84 at the University of Vienna and received the degree of doctor in the latter year. After this, he worked in succession in the Astronomical Observatory of Ogyalla, in the Central Office of Meteorology of Budapest, and as assistant to the celebrated geophysicist Baron L. Eötvös. In 1897, he was appointed professor of cosmography at Budapest. He was one of the founders of the International Association of Seismology, of which he was elected general secretary in 1905. From this time onward, he devoted himself almost exclusively to seismology, his contributions to the science relating to the angle of emergence of seismic waves, the general theory of earthquakes, the depth of the focus, the prevision of earthquakes, etc. He died on October 11, 1934, after a long illness.

WE regret to announce the death of Prof. Ettore Marchiafava, the eminent Italian malariologist. He was born on January 3, 1847, in Rome, where he qualified in 1872. After acting as assistant to Tommasi-Crudeli, he became professor of morbid anatomy at Rome in 1883, and succeeded Prof. G. Bacelli in 1916 in the chair of clinical medicine in the University of Rome, from which he retired in 1921. His works on the origin of melanæmia in malaria in conjunction with A. Celli (1887) and on æstivo-autumnal fever with A. Bignami (1894) have been translated into English in the New Sydenham Society's publications. He also wrote on diseases of the arteries, lungs and kidneys, and on the action of alcohol on the system.

WE regret to announce the following deaths:

Prof. Charles L. Jackson, emeritus professor of chemistry in Harvard University, known for his work in organic chemistry, on October 28, aged eighty-eight years.

Dr. A. F. Shand, known for his works on psychology, especially "The Foundations of Character", on January 6, aged seventy-seven years.

News and Views

Science in the Modern World

THE presidential address delivered to the Science Masters' Association, by Sir William Bragg on January 1 on "School Science after School" (see p. 78), was an impressive plea for the teaching of science in ways that will facilitate co-operation in dealing with national and international problems. The extraordinary growth of natural knowledge and the increase in community feeling, largely stimulated by the applications of that knowledge, are two of the great characteristics of our time. The school in its science teaching should therefore consider the community and not merely the individual and his own vocational and examination needs. The early members of the Royal Society, Sir William pointed out, unlike the fellows of the Society to-day, who are almost entirely professionals, specialists in some definite field of scientific study, pursued science as one of several interests. They were as much amateurs as they were professionals, and their scientific work was largely related to the welfare of the nation. In the pursuit of natural knowledge they found themselves always in touch with the world's affairs.

THERE is no splendid isolation for science, which indeed, said Sir William, would lose all its vitality if made to turn in upon itself. Science has always drawn inspiration from the attempt to solve the problems that continually occur in the nation's business, and the very necessity for specialisation to-day makes it essential for the chemist, the biologist and the physicist to keep contact if their own progress is to continue. Such contact often proves a great stimulus to further advance, and to-day alliances are also being established between science and industry—agriculture and other national occupations and interests. More than specialisation is demanded to-day, and because understanding depends largely on language, Sir William Bragg made a further plea that school teaching should see that while the scientific workers learn to express themselves logically and lucidly, others learn to understand the language and purpose of science. If in this way school science promotes the inclusion in one team of those representing many sides of life and their harmonious co-operation for the welfare of the nation, we need no longer fear the misuse or misdirection of the great powers with which science has endowed mankind.

Floods on the Continent

WHILE the peak level of the floods in the Thames Valley, reported in last week's issue of NATURE, has apparently been reached and passed, and the river, despite some additional rainfall during the week-end, is subsiding, less satisfactory reports are received from the Continent. Persistent rains all over France are stated to be causing the river discharges to assume alarming proportions, the conditions being unparalleled for a period of a quarter of a century. The Rhône, the Seine and the Loire give particular cause for anxiety. Along the banks of the last-named river, hundreds of dwellings have had to be abandoned under threatening conditions, and in Nantes itself the main railway line has been cut, while whole districts of the town are under water, which has penetrated the main squares of the city, causing business activity to be paralysed. In the Département of Vienne, "the worst flood for seventy years" has occurred at Poitiers, where many houses have been evacuated. The Rhône Valley is again invaded : both at Lyons, at the confluence with the Saône, and at Avignon, there are extensive flooded areas. From Toulouse, a "catastrophic" situation is reported. At Paris, the Seine has been rising at the rate of eighteen inches in twenty-four hours, and has exceeded danger level. Considerable lengths of quay front are submerged and cargo handling operations are seriously impeded, where not definitely suspended. Water has entered the buildings of the Quai d'Orsay, and the Place de la Concorde is inundated for the first time since 1910. The effects of excessive precipitation are being felt with equal severity in Spain, in the northern provinces of which widespread damage has been caused and the town of Padron isolated ; as also in Switzerland, where there have been a number of minor landslips, particularly in the Alps. The railway line to Chamonix has been completely blocked for some days by a mass of rock and stone. The authorities fear intensification of the trouble.

The Physical Society's Exhibition

THE Physical Society's twenty-sixth Annual Exhibition of Scientific Instruments and Apparatus was held in the Imperial College of Science and Technology, South Kensington, on January 7–9. Eighty firms exhibited their products in the Trade Section, in which many new instruments were shown for the first time. There were to be seen examples of recent applications of physics to a wide range of industrial problems, in addition to improved forms of the more usual physical instruments and apparatus. Four firms exhibited scientific and technical books. The Research and Experimental Section was again divided into two groups : Group A, illustrating recent research, contained exhibits contributed by research associations, Government laboratories and industrial and private laboratories, while Group B consisted of lecture and instructional experiments in physics. The annual competition in craftsmanship and draughtsmanship, held in conjunction with the Society's annual exhibition, attracted some eighty entries from apprentices and learners employed by exhibiting firms, or firms which have exhibited at previous exhibitions. The entries for this competition

were on view and attracted a great deal of attention. Discourses were given on two of the evenings; on January 7, Mr. R. A. Bull lectured on "Some Instruments used in Recording Sound on Films", and on January 8, Mr. R. W. Paul lectured on "Electrical Measurements before 1886". We understand that these lectures are being published in the special Exhibition Number (February) of the *Journal of Scientific Instruments*.

A New Electrical 'Eye'

ACCORDING to a report from its New York correspondent in the issue of January 4 of *The Times*, an electron tube device which is sensitive to both visible and invisible light was demonstrated on January 2 before the American Association for the Advancement of Science, by Drs. V. K. Zworykin and G. A. Morton. The device comprises an electron image tube of high overall magnification (compare NATURE, Jan. 4, p. 36) fitted with a fluorescent screen which acts as an artificial retina. The cathode emitter of this tube is operated directly by the incident light, which need not be in the visible range, since it is sensitive to radiation over the whole spectrum between 1,800 A. and 13,000 A. Thus the image which becomes visible on the fluorescent screen may be the result of incident radiation in either the ultra-violet or the infra-red portions of the spectrum. It would therefore appear that this electrical eye will literally enable us to see in the dark. If the further development of the device is successful, it is likely to be of considerable service in various branches of pure and applied science. It may, for example, provide the solution to the problem of navigation in fog on land and sea and in the air, while in astronomical and biological work, the use of infra-red radiation may reveal much that is not readily to be seen by visible light.

Suppression of Radio Interference

A DESCRIPTION is given in the *Electrician* of December 27 of experiments on the suppression of radio interference produced by trolley buses, carried out by Post Office engineers in several towns. At Southend, 'stopper' coils were fitted by the Corporation to its trolley buses. In most parts of the town the suppression of the interference was most satisfactory, but in a few parts of the town it had little effect. This was particularly noticeable in a narrow road in which the trolley bus track turned sharply at each end. Experiments with condensers fitted to the trolley poles were fairly successful in diminishing the disturbance in the troubled regions. Most of the interference was found to be due to the internal electrical equipment of the buses, and tests are being made by electric 'filters' to try to improve reception conditions. The weight of the stopper coils when placed on the top of the vehicles lowers the factor of safety for overturning tests and is therefore disadvantageous. Further tests on these coils has been postponed until the development of a lighter coil made of aluminium has been developed by the engineering department of the Post Office. In tests made recently on a G.E.C. Leyland trolley bus at Birmingham, good results were obtained by the application of interference filters to the individual items of the trolley bus equipment, and similar tests were carried out on one of the Hastings trolley buses. The items of the equipment causing interference were the controller, driving motor (60 horse-power) and collectors of the wheel type. Experiments showed that good suppression can be obtained by using these filters, but possibly line condensers will also be necessary. The tests show how serious the interference sometimes is when the weather conditions are bad, and that much of it can be suppressed by 'stopper' coils.

Fading of Radio Signals

THE phenomenon of fading has caused a great deal of trouble in radio-telephony. It is due to high-angle waves being reflected down from ionised layers in the upper atmosphere and interfering with the direct horizontal waves of the receiving station. By diminishing the former and increasing the latter, fading can be greatly mitigated or even entirely eliminated. In wealthy countries where people can afford to buy highly efficient receiving sets, and the broadcasting authorities can afford to erect more transmitting stations where necessary, the trouble is easy to overcome. In countries where many crystal and primitive valve sets are used, and the transmitting station serves distant receivers, the area for good reception is very limited. In this case, the area of reception can be considerably increased by the use of a single vertical antenna (aerial) instead of the usual *T*-type antenna suspended from two steel masts. The mast recently erected in Budapest for the broadcasting station is the highest structure in Europe. A description of it is given in *Links*, a paper published by Duckham and Co. Ltd., of 16 Cannon Street, London. The height of the antenna is 1,005 ft. and its weight is 230 tons. It is nearly three times the height of St. Paul's Cathedral. It rests on a porcelain insulator which has to withstand, owing to the pull of the guy ropes, a permanent crushing load of 480 tons. Compared with the old *T*-antenna, the Budapest vertical mast has more than doubled the service area of the station.

Bureau of Standards, Washington

THE Bureau of Standards publishes an interesting "Visitor's Manual" (Misc. Publ., M153), giving a brief synopsis of its history, functions and facilities. An afternoon visit to certain of the laboratory rooms is arranged every day. It is mentioned that the discovery of deuterium (heavy hydrogen) was the result of co-operative work of the laboratory with Columbia University. The use of the lowest temperature so far attained in the United States—the melting point of liquid helium (−456° F.)—has made possible the study of the properties of materials at very low temperatures, in particular the supra-conductivity of metals. The Bureau constructed the first 'altitude' laboratory for studying aeroplane engine performance under flight conditions. In it the low air pressures and temperatures encountered at altitudes up to

30,000 feet can be duplicated. The Bureau workers were the first to discover that a thin coating of pure aluminium greatly decreases the atmospheric corrosion of duralumin, an alloy largely used in aircraft construction. They worked out the very successful process of plating steel and other metals with chromium, the hardest metal known ; this more than trebles the life of gauges, printing plates and similar devices. The Bureau developed the paper now used for printing U.S. paper currency, which has extended the total service life of such notes at least three times. It discovered that certain waste water from paper mills makes satisfactory material for tanning leather, and it established the dextrose (corn sugar) industry. It keeps the public well informed of its work, and its staff has increased by fifty times since it began in 1903.

Emoluments in the U.S. National Bureau of Standards

THE U.S. Department of Commerce has issued a circular giving a description of the scientific and technical positions in the National Bureau of Standards. It is pointed out that the Bureau affords an excellent opportunity for training in scientific work, and is in close touch with industrial research. Many employees have found their post an excellent stepping-stone to more highly remunerative work outside. It is an excellent post-graduate training ground, and outside interests are ever on the alert to secure successful research workers. All positions on the staff are subject to the competitive requirements of the civil service rules and regulations. The Bureau staff comprises about 775 professional, 'subprofessional', clerical, administrative and custodial positions. All appointments are made at the entrance salary of the grade for which eligibles have qualified by examination. Examinations for posts in the lower grades are held throughout the country in every large city. Applicants for the higher grades do not have to sit for a written examination ; but are rated on their previous training and experience.

IN view of the present unemployment conditions in the United States, when any member of a single family living under one roof is in the service of the District of Columbia or of the United States Government, additional members of that family are not appointed. Assuming 5 dollars to the pound sterling, the following are a few of the rates of pay. In the 'professional service' which is the highest grade, there are eight divisions between 'junior' and 'chief'. A junior begins at £400 a year and ranges in seven steps to £500. A senior, which is the fifth grade, steps up from £920 to £1,080 and a 'chief' from £1,600 to £1,800. We are told that rentals for apartments and houses in the neighbourhood of the laboratories range upwards from about £165 a year, and that the cost of a room and board (two meals) is about £10 a month.

Protection of Antiquities in Nebraska

BY a resolution of the State Legislature of Nebraska, police powers over sites of archæological and palæontological interest have been conferred on the State Geological Survey, which will enable that service to control the future collection of antiquities and fossil bones, for which the State is widely known as a favourable locality. Although the efforts of the National Research Council have done much to make widely known among the people of the United States the desirability of preserving intact their monuments of antiquity, up to the present only a few of the States have taken legislative action to protect them ; and should the measures adopted in Nebraska prove effective, it is anticipated that other States will follow this example before long. As recent investigations have shown, Nebraska and the neighbouring States of the south-west are rich in relics of early man and of the extinct fauna with which, it would appear, early man was associated in this part of America ; but this wealth of material has proved an irresistible attraction to the amateur collector and the curio hunter, with the result that much important scientific evidence has been lost or destroyed by the removal of specimens from their stratigraphical context without adequate record, or indeed, in many instances, with no record at all. Some indications of the extent of the loss that science has suffered in this way is afforded by the references to important archæological specimens in private hands scattered throughout the records made by Prof. E. B. Renaud's archæological surveys of Colorado and adjacent territories. It has been specifically stated on behalf of the Geological Survey that there is no intention to restrict duly accredited scientific research.

F. W. Hodge Anniversary Publication Fund

IT is proposed to commemorate the services to anthropology of Dr. Frederick Webb Hodge, director of the South-West Museum, Los Angeles, during the fifty years in which he has been engaged in anthropological and archæological studies by the formation of a fund to assist in the publication of research work in the field of American prehistory. Dr. Hodge's career as an anthropologist began in 1886, when he joined the Hemenway South-western Archæological Expedition to Arizona. He became one of the pioneers in American anthropology, his best-known and undoubtedly most frequently consulted work being contained in the "Handbook of American Indians north of Mexico", of which he was editor and one of the principal contributors. He was one of the founders of the American Anthropological Association, editing its journal, the *American Anthropologist*, for the first fifteen years of its existence. He was for eight years head of the Bureau of American Ethnology, and has held his present office since 1932. The proposal for a publication fund to commemorate Dr. Hodge's long and strenuous career is put forward by a committee which is fully representative of the foremost anthropologists in the United States, including Dr. Aleš Hrdlička, Prof. F. Boas, Dr. Clark Wissler, Dr. A. V. Kidder, Dr. Fay-Cooper Cole, Dr. Bruno Oetteking, Dr. E. Sapir, and others. The fund will be administered as an endowment trust by the South-western Museum, and managed by an editorial committee to be nominated by the appealing Committee.

Research in Australian Sea Fisheries

PROF. W. J. DAKIN in his R. M. Johnston Memorial Lecture (*Pap. and Proc. Roy. Soc. Tasmania* for 1934 (1935)) gave a brief survey of various fisheries in all parts of the world and the methods of investigation. Then he proceeded to outline the needs of Australian fisheries. A beginning has been made in different directions, notably with age determinations and biology of the important commercial fish of New South Wales, the tiger flathead. Investigations are also being made into the life-histories of certain fishes and their eggs and larvæ, especially the Australian pilchard. Among the plankton studies one of special importance relates to the biology of the peneid prawns, the life-history of which is now being worked out by Prof. Dakin. The best-known prawns there are the king prawn, *Peneus plebejus*, and the school prawn, *Penæopsis macleayi*. During the winter, few or no prawns can be taken with nets and those captured are usually small; but in spring there comes a time when the king prawn can be caught in the lakes, and those first taken are small and come from the end farthest from the sea. Later, larger specimens are caught and then enormous outflows or 'runs' of large prawns take place on dark nights. The prawns flock to the entrance connecting the lake with the sea and can be captured in huge quantities. These large prawns are all immature and not quite fully grown, and it is now known that they are migrating to the sea in order to breed there. The eggs are shed in the open ocean and hatch as nauplii, the young migrating into the lakes there to feed and grow. The large prawns migrating to the sea from the lake are less than a year old—a most interesting life-history, and published here for the first time. *Penæopsis monoceros* appears to be exceptional in laying its eggs in the Swan River at Perth.

Forestry in New Zealand

AN important circular (No. 35, "New Zealand Official Year Book", 1935. Government Printer, Wellington, New Zealand) by Mr. A. D. McGavock, director of forestry, deals with the present policy of the Government on the subject of the forests and forestry in New Zealand. The circular, which merits a careful perusal by all interested in the development of a forest policy for the Empire as a whole, accords full recognition to the importance of the remaining indigenous forests to the future well-being of the country, and emphasises the importance among other species of conserving the remaining Kauri forests. "It is the intention of the State Forest Service," says the circular, "to bring the whole of the national Kauri forests under management plans which will ensure their perpetuation for all time." The general forest policy in New Zealand may be stated as the perpetuation of the indigenous forests and the provision of a supplementary exotic-forest capital which, by rapid growth, will eke out the supplies of indigenous timber and bridge the gap between the exhaustion of the over-mature indigenous forests, which otherwise would occur, and their conversion into healthy production forests. With the establishment of the exotic plantations now approaching completion, it will be possible to give proper attention to the sylvicultural treatment of the indigenous forests. The timber supply position of the future envisages a balanced yield from both exotic and indigenous forests, and the future alone will determine the relative importance of the two sources of supply. The chief remaining source of anxiety is the gigantic problem of undertaking successfully the thinnings now becoming necessary in the enormous area of State and privately owned plantations, aggregating some 672,000 acres; for an adequately trained staff of sufficient strength to cope with this delicate work does not appear to exist.

Oxidation and Scaling of Heated Solid Metals

FOR some time past the Metallurgical Research Board of the Department of Scientific and Industrial Research has been devoting special attention to the oxidation and scaling of heated metals. A critical survey of existing knowledge on this subject, the importance of which in the treatment, fabrication and use of metals needs no emphasising, is now available ("Review of Oxidation and Scaling of Heated Solid Metals". London: H.M. Stationery Office, 1935. 2*s*. 6*d*. net). Although the development of heat-resisting alloys has brought about considerable improvements, much still remains to be done before the troubles and losses due to the oxidation of metals are completely eliminated. The six sections of the review, each of which is contributed by a recognised authority, deal with the theoretical aspects of oxidation, the constitution and formation of scale on ferrous alloys, the quantitative consideration of the oxidation of iron and steel at elevated temperatures, the oxidation of non-ferrous metals and the industrial and practical aspects of the subject. In addition to providing a quite considerable amount of important information for immediate use, the review focuses attention on the problems upon which further research is required and will be found to be of the greatest assistance to other investigators of the same or cognate subjects.

History and Uses of Solders

BULLETIN No. 2, issued by the International Tin Research and Development Council, contains a very interesting account of the history and modern uses of solders in a wide variety of forms. The pamphlet of some fifty pages, which has been prepared by D. J. Macnaughtan, director of research, and Dr. E. S. Hedges, is available free of charge, to all who are interested in the now numerous industries in which solder is used, from the International Tin Research and Development Council, Manfield House, 378 Strand, London, W.C.2. In 1933, 18,000 tons of tin was employed in the manufacture of solders, of which 5,000 tons was used by the motor-car industry and 4,500 tons by the canning and box-making trades. The bulletin indicates the rapid progress which is being made in the use of soldered joints in air conditioning, central heating and refrigerating plant as well as in the electrical industry. The

ingenious types of machinery which have been designed for the soldering of parts in the motor-car radiator, and in the closing of tin plate cans, now produced in thousands of millions a year, are described. The compositions and physical properties of solders of representative grades are discussed and the reasons for the suitability of each kind for special purposes are shown. The importance of using the right type of flux is explained and practical details of the fluxing and tinning of a large number of metals and alloys are given. Not the least valuable portion of the bulletin is the appendix, in which are given references to a large number of the more important books, papers and specifications dealing with solders and the production of soldered joints.

Braking Efficiency of Modern Motor-Cars

AN abstract of a speech made by Prof. R. A. Moyer at the Annual Safety Congress, held at the Iowa State College, has been issued by Science Service, Washington, D.C. Prof. Moyer considers that on ordinary roads the present-day braking power of motor-cars when driven at their highest speeds is insufficient, and that they are decidedly unsafe. Safety lies mainly in providing low stopping distances. To provide the same stopping distance when travelling at 60 miles an hour as at 40 miles an hour requires brakes two and a half times as powerful. In Prof. Moyer's opinion, to maintain traffic speeds at about 45 miles an hour on open stretches of road would eliminate many of the risks arising from high speed. A study of traffic statistics shows that half the risk of accident would be eliminated if cars were forbidden to run at more than 55 miles an hour. If speeds greater than this are necessary, it would be far cheaper and probably equally safe to use an aeroplane. Prof. Moyer points out that Sir Malcolm Campbell needed a 2,500 horse-power motor to average 300 miles an hour on the salt beds of Utah—probably the most perfect race course in the world. On the other hand, an aeroplane with a 1,000 horse-power motor can reach 350 miles an hour in the air.

The British Accumulator Industry

WHEN the National Grid was established in Great Britain in 1926 and the Electricity Commissioners adopted alternating current as the standard for distribution, many thought that it would affect adversely the electric accumulator industry. In an address delivered to the Institution of Electrical Engineers by E. C. McKinnon on October 22, it is pointed out that this is not the case. The industry is flourishing, and accumulators have rendered practicable many new electrical applications. For submarines they are essential, and the evolution of the submarine battery in thirty-five years has led to increasing its average life threefold and trebling its capacity for a given volume. Since the first automobile self-starter battery came into service in 1911, numerous current consuming 'gadgets' have been added to the electrical equipment of the car, but in spite of this the present-day starter battery is much lighter, occupies much less space and gives a long life. Like the submarine, batteries for aircraft have called for much ingenuity in design. The cells for a large submarine may weigh 1½ tons each and their number ranges from 100 to more than 300. Each cell has a volume of about 20 cubic feet and has to be lowered intact into the submarine. An aeroplane battery has to be much lighter, its usual weight being about 46 pounds and its volume about 700 cubic inches. To meet the demands of aerobatics it must be absolutely unspillable in the inverted position. This is done by an ingenious hydrostatic device, and not by using a jellified electrolyte. There is a large demand for accumulators for automatic telephone purposes and for train 'lighting and cooking'. One of the widest applications for batteries nowadays is for emergency and standby purposes. A battery can ensure continuity of illumination for traders during busy periods, when a 'black-out' would be serious, and in hospitals. It is interesting to notice also that for many auxiliary services in connexion with the National Grid supply, there is a considerable demand for accumulators.

Japan and Electric Communication

ELECTRICAL communication industries are developing very rapidly in Japan. There are a million telephones in use, and two million homes have radio receiving sets. The Institute of Telephone and Telegraph Engineers has now five thousand members, and publishes a valuable technical journal every month. It has been decided to increase its usefulness by publishing every quarter an English edition of it. In the first English journal, the president of the Institute, Mr. T. Akiyama, says that their present knowledge of the technique of electrical communications has been obtained largely from abroad, and that it is their duty to bring to the notice of foreign countries their own achievements in research and so repay the friendship shown to them through many years. By so doing it is hoped to contribute to the general advance of civilisation. It is stated that limited land and over-population have placed Japan in a position in which the nation cannot exist on agriculture alone; it is forced to turn to manufacturing industry for its welfare. At the present time, approximately 40 per cent of the Japanese population is engaged in commerce and industry. Japan is the boundary line between Asia and the Pacific Ocean. It is the duty of Japan to provide national and international communication networks so as to help to harmonise the Oriental and the Western civilisations. The development of radio communication in Japan has been largely due to their own initiative, and practically all the transmitting apparatus is of their own manufacture. There are twenty-five broadcasting stations which are run by a company under the supervision of the Government. They are all interconnected by wire lines. The Japanese director-general of engineering says that their ideal is to help the fusion of cultures by keeping in constant touch with the other nations of the world. The journal, *Nippon Electrical Communication Engineering*, is a useful contribution to technical literature.

Measurement

THE extended use in industry of more accurate measuring instruments of all kinds led the Chamber of Commerce of Paris in 1932 to institute at the Conservatoire National des Arts et Métiers a course of lectures on measurement which have been delivered annually by Prof. Pierre Fleury of the University of Lille. They cover units and standards, legislation, calculation for all types of measurement, details of the methods available for making measurements in geometry, kinematics, statics, dynamics, heat, sound, light and radiology. As no treatise existed in French dealing with these subjects completely, Prof. Fleury decided to compile a work covering the whole field, and the first part, entitled "Généralités sur les mesures", appears as No. 236 of the series of "Actualités scientifique et industrielle" (Paris : Hermann et Cie. 15 francs). It is a pamphlet of about 80 pages, and deals with choice of methods, estimation of errors, calculations and verifications, units and standards. With six others which are to appear in the same series, it will constitute Prof. Fleury's "Leçons de Métrologie générale et appliquée" and should prove of great value in introducing more systematic methods into industry.

Development of Marine Engines

THERE is nowhere a finer collection of marine engineering models than in the Science Museum, South Kensington, and the collection also contains actual engines of great historical interest, including Symington's engine of 1788, the engine of the *Comet* of 1812 and the complete turbine installation of the *Turbinia*. The collection is therefore one which should be widely known. A catalogue of the engines and boilers and their accessories compiled by Mr. G. L. Overton, the keeper of the Water Transport Section of the Museum, was issued in 1926, and he has now written a handbook tracing their history and development (London : H.M. Stationery Office, 2*s*. net). In this, there are chapters on experimental and early marine propulsion, paddle engines, reciprocating steam screw engines, marine steam turbines, marine internal combustion engines, marine steam boilers and marine propellers. In such a work, it is, of course, only possible to trace the main lines of progress ; but it may be safely said that anyone desirous of studying marine engineering history could not have a better foundation on which to build than this well-written and well-illustrated handbook. The book includes a list of the more important works on the subject to be found in the Science Library.

Bacon Production

"THE PRODUCTION OF PIGS FOR BACON" formed the subject of the nineteenth of the Rothamsted Conferences (Secretary, Rothamsted Experiment Station, Harpenden. 1*s*. 6*d*.). Bacon production involves a number of persons, and it is essential that a better understanding between them should be reached if the industry is to be carried on successfully. The papers deal with different practical problems, and are published in full, together with the discussion, in which representatives of all points of view took part. On the production side, Mr. A. E. Law sets out the details of his management and Mr. H. R. Davidson critically examines the present bacon contract, showing that in the matter of belly measurement, conditions imposed in England are more severe than those in Denmark. Dr. J. Hammond discusses the points that constitute good carcase quality in a bacon pig, and Mr. A. E. Marsh gives the curer's point of view. The requirements of the factory are discussed by Mr. J. B. Busby. Although these are fairly well defined, the best way of meeting them is admittedly less definite, and further scientific work is also needed on breeding and feeding problems.

The Pasteur Institute of Southern India, Coonoor

THE annual report of the director of this Institute, Major K. R. K. Iyengar, for the year 1933, has recently been issued. During the year under review, 417 patients underwent the complete course of treatment, and 83 underwent incomplete treatment. For the first time since the Institute was opened twenty-seven years ago, there were no deaths from hydrophobia among those treated. The Paris 'fixed virus' was in use throughout and was in its 912th passage at the close of the year, Semple's carbolised 5 per cent sheep vaccine being employed. Besides treatment at the Institute, 10,477 courses of anti-rabic vaccine were issued to a number of other centres, together with 22,550 c.c. of vaccine for veterinary use, 335 animals being thus treated. In addition, 298 brains of rabid or suspected rabid animals were examined, and 1,530 specimens were received for clinical and bacteriological examination.

Plant Diseases in New South Wales

A VERY extensive list of more than 1,260 plant diseases recorded in New South Wales has recently appeared (Dept. Agric. N.S.W., Science Bulletin No. 46. Sydney : A. J. Kent, Govt. Printer, 1935). It is compiled by Dr. R. J. Noble, Messrs. H. J. Hynes, F. C. McCleery and W. A. Birmingham. The territory under investigation has been divided into sixteen geographical divisions, but the records mostly indicate the actual district in which a particular disease has been found. The names of host plants are arranged very conveniently in alphabetical order, and the names of the parasites follow a similar plan. Common names and dates of first appearance are included. Diseases of major importance are indicated by an asterisk, and many parasites of fruit and the commoner agricultural crops come into this category. The publication is certainly as complete and useful as a list can be.

Japanese Beetle in the United States

ACCORDING to Science Service, Washington, D.C., the Japanese beetle (*Popillia japonica*) was at its peak of abundance in the United States during July and early August. The insect appears to be still extending its range in the eastern United States, and large metropolitan areas of New York, Philadelphia, Baltimore,

etc., have become affected, where the beetles are being found in the streets, parks and suburban areas. In New Jersey, thousands of examples were blown by storms into the ocean, only to be cast back by the waves on to the beaches of summer resorts, to the great discomfort of bathers. The insect was accidentally introduced in the larval stage in soil around the roots of a shipment of Japanese iris to New Jersey in 1916. Since then it has spread with great rapidity and become firmly established as a most destructive immigrant enemy of fruit and shade trees, vegetables, etc.

British Institute of Philosophy

THE British Institute of Philosophy was founded in 1925, with the late Lord Balfour as its first president, its aim being the cultivation of systematic thought that has the most intimate bearing on practice. An appeal has now been issued, over the signatures of leaders of philosophical and scientific thought, for support to enable the Institute to extend its activities. These consist at present of the publication of the quarterly review *Philosophy*, the holding of courses of public lectures, the organisation in London and other cities of reading circles, and the arrangement of monthly evening addresses by leaders of opinion in various departments of thought, scientific, æsthetic, political, moral and religious. The annual subscription is £1 1*s*., which covers the price of the quarterly review; further information can be obtained from the Director of Studies at the rooms of the Institute in University Hall, 14 Gordon Square, London, W.C.1.

Staffordshire Field Naturalists

THE Transactions for 1934–35 of the North Staffordshire Field Club contain reports of the work of the various sections, including accounts of excavations at Wroxeter and other archæological remains. The sixth instalment of T. Smith's "Birds of Staffordshire", contained as an appendix, indicates how many birds, now rare or extinct, have appeared in the county; for in the list of Accipitres alone are the names of hen-harrier, marsh-harrier, golden and white-tailed eagles, goshawk, kite and osprey.

Further Gift in Dovedale to the National Trust

DURING the past two years, the National Trust has, through the generosity of private benefactors, secured the preservation of considerable parts of Dovedale, Derbyshire. On December 31, Mr. E. Hodgson Kerfoot of Buxton and Manchester presented, in commemoration of the Silver Jubilee, the Iron Tors and the Nobbs, 100 acres in all. The Iron Tors are bold outstanding limestone buttresses with varied woodland immediately north of the property presented by Imperial Chemical Industries. The Nobbs is also situated on the Derbyshire side of the River Dove opposite the Hall Dale property presented by Mr. McDougall, about seventeen miles from the source on the Derbyshire moorland height of Axe Edge.

Announcements

THE celebration of the one hundred and twelfth anniversary of the foundation of Birkbeck College (University of London) will be held in the College Theatre on Wednesday, January 22. The foundation oration will be delivered by Sir Frederick Gowland Hopkins, past president of the Royal Society. The chair will be taken by Mr. W. L. Hichens, chairman of the governors, at 8.15 p.m. No tickets are required.

AT the invitation of the Royal Society, the North East Coast Institution of Engineers and Shipbuilders will arrange the first of the annual lectures to be held in connexion with the memorial to the late Sir Charles Parsons. The Institution has nominated Sir Frank Smith to deliver the lecture and the Council of the Royal Society has approved of the nomination. The lecture will be held in Newcastle upon Tyne, probably in the latter part of 1936.

THE Dutch Association for Genetics has offered a prize of 250 gulden for the best work on the inheritance of differences in resistance to disease in man and animals. The work must contain a review of the literature, especially as regards diseases of the blood, personal observations and conclusions. It should be sent to the Secretary of the Association, A. L. Hagedorn, Soesterberg, Holland.

WE regret to find that, in printing the issue of NATURE of January 4, the graph on p. 30 in the letter entitled "Recombination of Neutron with Proton" by S. Kikuchi, K. Husimi and H. Aoki has been inverted. The letter *b* on the left hand side of the diagram thus refers to the bracket now appearing on the right; the numbers at the foot of the diagram are not affected. The block was unfortunately inverted after the page had been passed for press.

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

An engineering assistant in the War Office—The Under-Secretary of State (C 5), The War Office, London, S.W.1 (Jan. 13).

A demonstrator in the Engineering Test Laboratory and the Physics Laboratory in the Royal Naval Engineering College, Keyham, Devonport—The Adviser on Education, Admiralty, Whitehall, S.W.1 (Jan. 27).

A senior lecturer in zoology in Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for South Africa, South Africa House, Trafalgar Square, London, W.C.2 (Jan. 31).

A junior lecturer in civil engineering (Jan. 29), and a professor of geography (Feb. 4) in the University of Capetown—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, London, W.C.2.

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 72.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Atomic Dynamics of Plant Growth

SOME years ago, one of us investigated the circulation of lead[1] in plants using a radioactive lead isotope as indicator. Recent developments in nuclear chemistry make it possible to prepare radioactive isotopes of several of the light elements which, in contrast with lead, are the chief components of plant tissue. This enables us to investigate whether the atoms building up the tissues of the plant remain in their places or migrate during growth to other parts of the plant.

Let us, for example, consider the phosphorus atoms present in the lowest leaf of a maize plant; during the growth of the plant a second leaf will appear and the question to be decided is whether the first leaf gives up its own phosphorus atoms partly or wholly to build up the second leaf, or whether the phosphorus atoms carried up through the 'stem' (in reality undeveloped leaves) from the soil or from a culture solution are responsible for the formation of the second leaf. To solve this problem, the method of isotopic (radioactive) indicators can be applied, using as indicator the radioactive isotope of phosphorus $_{15}P^{32}$, which has a half-life of about a fortnight. We prepared this isotope by bombarding carbon disulphide, in which a few milligrams of phosphorus were dissolved, with neutrons from a mixture of beryllium and a few hundred millicuries of radon, distilled off the carbon disulphide, oxidised the remaining phosphorus, and converted the phosphoric acid formed into sodium phosphate.

Time of the experiment (days)		Weight of ash (mgm.)	Weight of the total P (mgm.)	'Radioactive' P (mgm.)	'Radioactive' P / Total P
3·8	Stem	53·8	2·05	0·806	0·395
	Leaf	32·9	1·12	0·358	0·318
7·0	Stem	44·0	1·39	0·878	0·630
	Leaf	33·0	1·16	0·528	0·445
13·8	Stem	136·5	5·74	4·21	0·733
	Leaf	52·9	1·95	1·31	0·672
21·0	Stem	157·9	5·45	4·31	0·791
	First leaf	34·3	0·903	0·64	0·709
	Second leaf	197·6	7·17	5·01	0·698

Small maize plants were grown for ten days in a culture solution of the usual composition and were then transferred to another culture solution in which the ordinary phosphorus was replaced by an equivalent amount of 'radioactive' phosphorus. Since the phosphorus isotopes cannot be separated by chemical processes, it follows that if, for example, one per cent of the radioactivity added to the culture liquid is found to be present in any part of the plant, we can conclude that one per cent of all those phosphorus atoms which were present initially in the culture solution are also present in that part of the plant. We will call the last mentioned phosphorus for the sake of brevity 'radioactive phosphorus'. If we now determine by both chemical and radioactive analysis the phosphorus content of, for example, ash obtained after ignition of a leaf, we can determine how much of the total phosphorus present originated from the culture solution, that is, the 'radioactive phosphorus', and how much was already present in the plant at the beginning of the experiment. The result of the chemical and the radioactive analysis is seen in the accompanying table.

The chemical analysis was carried out by the colorimetric method described by Lohmann and Jendrasik[2], and the radioactive analysis by comparing the activity of the ash of leaf or stem with that of a known part of the radioactive phosphorus applied. In the last experiment the first and the second sets of leaves seen in Fig. 1 were ignited after the plant

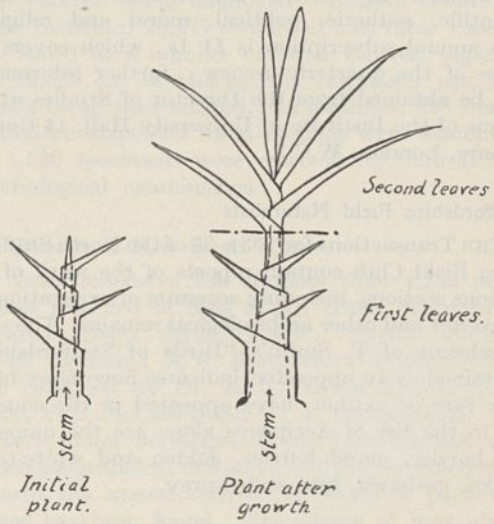

FIG. 1.

had been growing for 21 days in a culture liquid; the stem was also ignited. 79 per cent of the phosphorus content present in the stem was found to be 'radioactive' phosphorus originating from the culture solution, while the remaining 21 per cent was part of the ordinary phosphorus already present in the plant at the beginning of the experiment. For the lower and the higher leaves the corresponding figures are 71 and 70 per cent respectively 'radioactive' phosphorus and 29 and 30 per cent respectively ordinary phosphorus.

The practically identical ratios of radioactive phosphorus, originating from the culture liquid, to ordinary phosphorus, in the first and the second sets of leaves clearly indicate that the phosphorus atoms of the leaves are present in a mobile state, and that during the growth of the plant a continuous

interchange of phosphorus atoms takes place between the different leaves. The data in the table show also three intermediate stages in the phosphorus uptake of the plant and an increase in the ratio of 'radioactive' to total phosphorus with time.

The fact that the easy exchangeability already found for lead, which is only incidentally present in plant tissues, has also been ascertained for phosphorus, one of the chief constituents of plants, indicates that we have to do with a general property of plant constitution. To investigate this point closer, it is intended to continue these experiments with other elements.

We wish to express our thanks to Prof. Niels Bohr and Prof. S. P. L. Sørensen for the kind interest taken in this work.

G. HEVESY.
K. LINDERSTRØM-LANG.
C. OLSEN.

Institute of Theoretical Physics
and Carlsberg Laboratory,
Copenhagen. Dec. 9.

[1] G. Hevesy, *Biochem. J.*, **17**, 439 (1923).
[2] Lohmann and Jendrasik, *Biochem. Z.*, **178**, 419 (1926).

Biological Distribution of Metals

PROF. H. TER MEULEN'S work on molybdenum in plants[1] suggests some fundamental problems which will be best solved by spectrum analysis. The quantities of molybdenum recorded, 0·01–0·07 mgm. per kgm., are very much smaller than those in which other metals occur in plant tissues, and it is from a study of several elements, perhaps, that fundamental explanations may be discovered.

Plants and animals use certain of the elements available in the soil or food, and each form of life makes its own selection and, presumably, does so for its own peculiar metabolic needs. There are other elements which are taken in without selection and circulate in the concentration natural to those sources and, in animals at least, are passed out with the waste; in these cases the quantity of the element found will vary according to the quantity and quality of the circulating fluid in the tissue.

Many facts regarding the selective secretion of metals have been described in a paper on "Application of the Spectroscope to Biology"[2]. The position in plant life is not so simple as in animals, but results obtained from wheat plants, seeds, etc., indicate that metals used by plants are finally stored up, partly or wholly, in the seeds, a proof, perhaps, of their need and employment in the plant's economy.

Not only are certain metals stored in the seeds but also there are definite distributions of metals in the several parts of the seeds. Three analyses of seeds may be cited:

(1) *Apple seeds.* Three parts, dried in a steam oven, were studied—(*a*) the brown outer case; (*b*) the thin translucent coat of the endosperm; and (*c*) the endosperm. The average percentage results obtained from seven samples of apples, home and foreign, were as follows:

Sample	K	Mg	Ca	Sr	Mn	Cu	Fe
a	0·43	0·13	0·97	0·0050	0·0020	0·002	0·006
b	0·71	0·117	0·20	0·0005	0·0134	0·004	0·009
c	1·30	0·197	0·11	—	0·0023	0·005	0·0093

The uniform concentration of manganese in (*b*) is a noteworthy feature. Pear seeds gave somewhat similar results.

(2) *Seeds of the india rubber tree:*

Sample	K	Rb	Mg	Ca	Sr	Mn	Cu	Fe	Ni
Outer part of shell	—	—	trace	0·04	—	trace	trace	trace	—
Inner part of shell	0·5	0·009	0·09	0·50	0·003	0·007	0·008	0·01	trace
Coat of endosperm	1·8	0·050	0·08	0·08	0·001	0·006	0·013	0·025	trace
Endosperm	1·3	0·030	0·20	0·04	trace	trace	0·006	0·05	0·001

Traces of silver were present in all except the outer shell. The presence of so much rubidium is remarkable and it is also a notable constituent of latex.

(3) *Brazil 'nuts'.* Barium has rarely been found in plants or animals, but Seaber reported its presence in Brazil 'nuts'[3]. He analysed the outside and inside parts of the kernels and found up to 0·29 per cent of barium. The flame spectrographic method, by direct analysis of 0·025 gm., will detect about 0·08 per cent of barium, but no indication of that metal was found in either the outer or inner parts of the shell, or the endosperm; but the thin dark brown coat of the endosperm contained 0·7 per cent. Using larger quantities of the endosperm the presence of barium was detected, and the outer layers were found to contain more than the centre. These 'nuts' were of the Manáos variety.

A further step would be to germinate seeds such as the above and follow the metals into the parts of the stem, leaves, etc.

Nickel and cobalt are elements worthy of study, since they occur in a number of plant and animal tissues. Nickel was found in one fifth of the spices and herbal drugs analysed, mostly in traces, but St. Ignatius beans contained 0·014 per cent along with 0·003 per cent of cobalt, 0·03 per cent of manganese and 0·05 per cent of lithium. Nickel is present in tea and is constantly entering the human body. Cobalt occurs less frequently; but it appears to be a necessary constituent in the food of sheep as, in minute doses, it relieves and gradually cures 'coast disease' in Australia[4]. A similar disease, now under investigation, occurs in parts of New Zealand, and this has been cured by giving the sheep suspensions of each of two soils on which the disease does not occur. It is interesting to note that these two soils contain cobalt and nickel, while the soil on which the disease was contracted gave no indication of either metal.

Ter Meulen states that in a dozen different trees studied the molybdenum returns with the fallen leaves to the soil but that horse-chestnuts contain molybdenum which, in all probability, they withdraw from the leaves as they mature. In a previous communication[5], he reported high proportions of molybdenum, 3–9 mgm. per kgm., in beans and peas; all these indicate its concentration in the seeds. Presumably, in all the cases named above, the metals function in the leaves and are required also for the germination, etc., of the seeds. It is possible that the failure of the attempts to grow Brazil 'nuts' in Malaya and New Mexico may have been due to the lack of barium in the soils.

HUGH RAMAGE.

Carrow Hill,
Norwich.
Dec. 17.

[1] NATURE, **136**, 78 (1935).
[2] Ramage, S.-E. Nat. and Antiq., Norwich Conference, 54 (1933).
[3] Seaber, *Analyst*, **58**, 575 (1933).
[4] NATURE, **136**, 518 (1935).
[5] NATURE, **130**, 966 (1932).

Transparency of Sea-Water

THE transparency of sea-water has hitherto been studied, either by means of the Secchi disc or, more recently, by measuring the intensity of submarine daylight at different depths by means of photo-electric cells. Both methods are limited to comparatively small depths, where the residual daylight has a measurable intensity. In addition, the results, if no colour filters are used, are affected by the changes in spectral composition which daylight undergoes with increasing depth.

For some time, an instrument specially constructed for measuring *in situ* the transparency of sea-water to electric light has been used from this station as well as from our research ship the *Skagerak*[1]. A horizontal beam of electric torch-light passing from a closed metal casing into the water through a plate-glass window, and reflected by a mirror at a distance of one metre, passes through a second window on to a rectifying selenium cell. A 4-lead rubber-insulated electric cable serves to carry the lamp-current from a battery of storage cells and also for connecting the rectifying cell with a micro-ammeter, on which the photo-current is read. Keeping the lamp current perfectly constant, the intensity of the photo-current gives a measure of the transparency of the 2 metres of sea-water through which the light passes, and thus affords means for calculating the extinction coefficient of the water for the light used. The transparency meter, which is quite simple to use, has revealed surprisingly abrupt changes in the transparency of the sea-water in our fjords at certain depths, where the photo-current may vary by fifty per cent or more within a layer less than 1 metre thick.

A similar instrument without mirror serves to measure the light scattered backwards from a strong beam of light projected into the water. The curves giving the intensity : depth relation obtained, on one hand with the scattering meter, and on the other hand with the transparency meter, are found to be antisymmetrical to one another, a sharp maximum in one curve corresponding to an equally distinct minimum in the other curve. This indicates that the large variations with the depth found in the transparency are mainly due to the presence of suspended particles in varying amounts. A microscopic examination of the particles has shown them to be largely organic, either detritus or, at certain seasons, phyto-plankton. Either of the two instruments here described, therefore, affords a simple means for discovering and locating the 'clouds' of organic particles occurring at certain depths, which are of outstanding importance to biologists[2].

Recently, with a transparency meter constructed for work in greater depths, the transparency of the water in the central Skagerak has been investigated down to a depth of 500 metres. In 250 metres depth, a maximum transparency was found, whereas the influence from the bottom sediment, affecting the transparency of the lowest strata, was observable already at 50 metres above the bottom. On the other hand, in isolated depths within the fjords, the water less than 1 metre above the sea-bottom was found to have a high transparency, proving the water to have been at rest for a considerable time. Thus conclusions regarding the movements of the bottom-layers may be drawn from measurements of the transparency.

Bornö Station. HANS PETTERSSON.
Nov. 30.

[1] *Meddel. Oceanogr. Inst.*, Göteborgs Högskola, Nos. 7 and 9 (1934).
[2] *J. Conseil Perm. pour l'Expl. de la Mer*, **10**, (1), 48 (1935).

Experimental Investigation on the Magnetic Double Refraction of Ionised Air

THE theory of the propagation of electromagnetic waves in the ionised upper atmosphere of the earth, as influenced by the earth's magnetic field, has been developed by Appleton[1], Hartree[2], Goldstein[3] and others. Investigations on the magnetic splitting and polarisation of radio waves returned from ionospheric layers have confirmed this so-called magneto-ionic theory. Laboratory experiments have also been carried out in this connexion. Benner[4], for example, has shown that at the approach of the critical value of the magnetic field (He/mc = the angular frequency of the incident waves), the values of the refractive index and the conductivity of a space containing free electrons change abruptly. Similar observations have been made by H. Gutton[5], and by Jonescue and Mihul[6]. Appleton and Childs have shown[7] that at this value the absorption of waves is greatly increased.

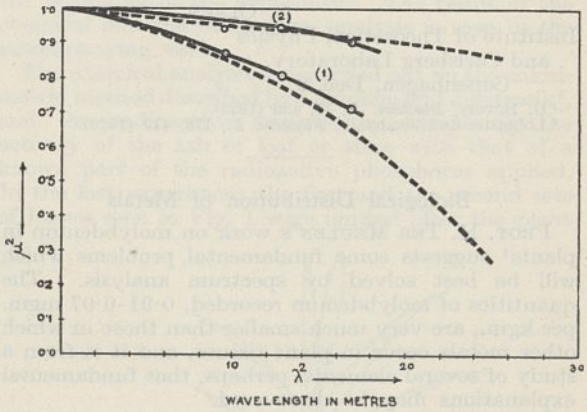

FIG. 1.

All these observations, from the point of view of the magneto-ionic theory, are for the so-called transverse type of propagation, and were made primarily with the object of demonstrating the phenomenon of magnetic resonance. The most striking result of the magneto-ionic theory—the phenomenon of double refraction—has not, however, received adequate attention from experimental investigators, and, so far as we are aware, the only work in this connexion is that carried out by Keck[8], who, working with a wave-length of 4 cm. (spark-generated), has observed the Faraday effect in ionised gas in the presence of a magnetic field and explains the rotation of the plane of polarisation as due to double refraction.

We have recently carried out experiments in which, with a very simple disposition of apparatus, the actual splitting of the wave traversing a column of ionised gas under the influence of a steady magnetic field is observed, and the dispersion and the differential absorption of the split waves studied quantitatively.

The experimental arrangement was the same as that described in a recent note by Mitra and Banerjee on their study of the dielectric constant of ionised air[9]. The discharge tube containing the ionised air is placed between a pair of Lecher wires with its length parallel to them. The Lecher wires are energised by a high-frequency valve oscillator (λ = 3–4 m.), and the lengths of the waves propagated along the lines, through the ionised air in the discharge tube, are measured in the usual way by noting the positions of resonance on the wires. A cylindrical

coil of wire carrying current for producing the magnetic field is placed co-axially with the discharge tube. The case studied is thus one of longitudinal propagation. Two sets of experiments were carried out. In the first set, the magnetic field was kept constant and the frequency of the propagated wave varied, and in the second set the frequency of the propagated wave was kept constant and the magnetic field varied. The electronic density was kept constant in both the cases. Full line curves in Figs. 1 and 2 are plotted from results of two such typical sets of experiments.

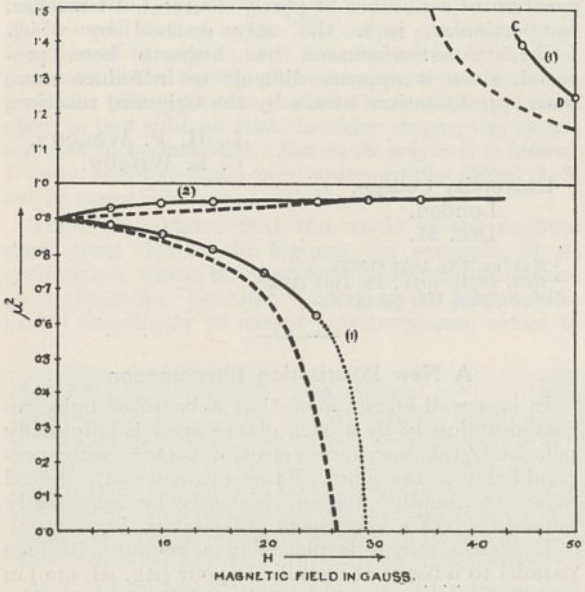

FIG. 2.

The curves may be interpreted after the magneto-ionic formula, for the case of longitudinal propagation, in the following way. (The number of collisions of electrons and ions with the gas molecules is assumed to be small compared with wave frequencies.)

We have :

$$\mu^2 = 1 - \frac{x}{1 \mp y},$$

$$\text{where } x = \frac{4\pi Ne^2}{mp^2}, \quad y = \frac{He}{mcp},$$

μ the refractive index, H the impressed magnetic field in gauss, N the electronic density, p the angular frequency of the propagated wave, c velocity of light, e (E.S.U.) and m electronic charge and mass respectively. The expression for μ^2 shows that, in general, it has two values, except when $x = 0$, or $y = \infty$, in which cases $\mu^2 = 1$. When $y = 1, \mu^2 = \infty$ for the upper sign.

The broken line curves in Figs. 1 and 2, drawn from calculated values, show how μ^2 varies with λ (H constant) and with H (λ constant) near the critical value of the magnetic field. The curves marked (1) are for the upper sign and those marked (2) are for the lower sign. The full line curves are drawn from experimental values ; they show that for the portions which could be observed the nature of the curves agrees very satisfactorily with the theoretical curves. The occurrence of 0, 1 and ∞ values of μ^2 is evident in both sets of curves. Since the solenoid for producing the magnetic field was not long enough to make the field uniform throughout the entire length of the discharge tube, the experimental curves do not actually coincide with the calculated curves. For the purpose of calculation the value of the magnetic field at the centre of the solenoid was used. In Fig. 2 the full line experimental curve reappears in the upper right hand corner (CD) after passing through infinity. In Fig. 1, on account of absorption, it was not possible to observe this portion. The anomalous increase of the value of the refractive index when the leakance between the Lecher wires becomes large due to increase in the conductivity of the ionised air, as mentioned by Mitra and Banerjee[9], was also noticed in this case.

In order to measure absorption for any particular wave-length, a curve is drawn between the galvanometer deflections and the positions of the bridge on either side of the resonance point. The attenuation constant of the Lecher system, considered as transmission lines, is calculated from this curve and the value of the conductivity obtained therefrom by a method similar to that employed by Banerjee[10] for measurement of radiation resistance of high-frequency parallel wire transmission lines. It is found that, as predicted by theory, there is a marked difference in absorption between the two split components. The component with the lower refractive index is more strongly absorbed than that with the higher when the propagation is along the direction of the magnetic field.

A more detailed account of the observations will be published elsewhere.

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Thermal Conductivity Method for Following the Electrolytic Separation of Hydrogen Isotopes

A RAPID and accurate method for determining the concentration of deuterium in small quantities of hydrogen gas is needed in order to be able to follow readily the separation of hydrogen isotopes during electrolysis of solutions containing heavy water. Methods dependent on the thermal conductivity of the gas are particularly attractive for this purpose, and a micro-method of this type using the gas at about 0·04 mm. pressure has been described by A. and L. Farkas[1]. In attempts to apply this method, however, we did not succeed in finding conditions yielding reliable results of the accuracy required ; and, from a consideration of the factors influencing thermal conductivity, operation at a notably higher pressure seemed more promising, since the measurement then rests on a simpler and more definite physical basis[2]. A method has accordingly been developed using gas at 10 cm. pressure. About 10 c.c. of gas at N.T.P. is needed for a determination, but the probable error is only about 0·1 per cent of deuterium.

A thin platinum wire is mounted on platinum springs along the axis of a glass tube into which the gas to be examined is introduced at the specified pressure. The electric current required to maintain the wire at a definite temperature (about 50° C.), when the tube is immersed in a well-stirred ice bath, is accurately measured. 'End effects' are corrected for by the use of a compensating tube[3].

Comparative determinations of the proportions of deuterium in the cathode gas during electrolysis of solutions of known heavy water content (c per cent) under various conditions are made by taking alternate measurements of the current (I) required to maintain the temperature of the wire in the thoroughly dried gas sample, and of the current (I_0) required in pure H_2 under identical conditions. After correcting for 'temperature drop'[4], $(I_0 - I)/I_0$ may be taken as proportional to the concentration of deuterium in the gas, if this concentration is not very large; and $(I_0 - I)/I_0c = \alpha'$, as a relative measure of the separation coefficient (α). Although the factor required to convert these comparative values into absolute values has not yet been determined, the sensitiveness of the method can be judged from the following results for successive samples (taken at about 20 minute intervals) of the gas evolved from a gold cathode at 10 amp./sq.dm. in N NaOH solution containing 14·9 per cent of D_2O at 25° C.:

I_0	I	$\frac{(I_0 - I)}{I_0}$
0·57092		
	0·56832	0·00465
0·57103		
	0·56840	0·00466
0·57110		
	0·56836	0·00479
0·57110		
	0·56843	0·00470
0·57114		

With most cathode materials, values of $(I_0 - I)/I_0$ remain as constant as in the above example during 2–3 hours electrolysis at 10 amp./sq.dm.: in cases where large changes do occur, they are generally accompanied by parallel changes in the cathode potential (e) at which the gas is evolved, and can thus be attributed to an alteration of the cathode surface. Variations in the value of α' with different metal cathodes in solutions containing 15–25 per cent of D_2O appear to be much less in alkaline than in acid solution, and in the latter the values for a number of metals seem to be simply related to e.

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Preparation of Partly Deuterated Benzenes

IN a preliminary report[1] of researches on the long-wave spectroscopy of the deuterobenzenes it was mentioned that 1 : 3 : 5-trideuterobenzene, an important compound spectroscopically on account of its trigonal symmetry and the absence of a centre of symmetry, had not been obtained, although various other partly deuterated benzenes, together with hexadeuterobenzene, had been examined. The *s*-tri-derivative has now been made (m.p. 6·1°).

In a paper which has just appeared, Erlenmeyer and Lobeck[2] describe the preparation of hexadeuterobenzene by decarboxylation of mellitic acid, through its salt, with calcium deuteroxide. This is of interest inasmuch as there has been disagreement with regard to the physical constants of hexadeuterobenzene, and the constants obtained by these authors exactly confirm ours[3].

Our hexadeuterobenzene was prepared by the sulphuric acid exchange reaction, but the method of decarboxylation with calcium deuteroxide is one of those which we have used with success for the preparation of a number of partly deuterated benzenes. In particular, it is the only method by which 1 : 3 : 5-trideuterobenzene has hitherto been prepared, since it appears difficult to introduce more than two deuterium atoms by the Grignard reaction.

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[1] NATURE, **135**, 1033 (1935).
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A New Polarisation Phenomenon

IT is a well-known fact that a beam of light reflected obliquely by a dark glass mirror is elliptically polarised, the maximum electric vector being perpendicular to the plane of the incident and reflected rays. A metallic mirror, perfectly or imperfectly polished, gives a very weak polarisation.

If such a mirror is placed in a vacuum, its face parallel to a beam of metallic vapour (Ag, Al, etc.) in such a way that no molecules of the main beam can strike it directly, but only those diffused by collisions in the beam, an extremely thin deposit of metal can be obtained on the mirror. It is difficult to ascertain the thickness of the deposit; but it is probably much less than 10^{-7} gm. per square centimetre.

A metallic mirror which has been treated in this way produces a very strong polarisation of oblique light, reflected or diffused. According to the thickness of the deposit, the maximum electric vector is perpendicular or *parallel* to the plane of the incident and reflected rays. Under similar experimental conditions, the light diffused by an imperfectly polished mirror is completely polarised.

The intensity of polarisation depends on the wavelength, but is not modified by a rotation of the mirror around an axis perpendicular to its surface.

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Ontogeny of the Angiospermic Carpel

SOME recent morphological interpretations of the angiospermic gynœcium deny or greatly modify the classical interpretation that the carpel is a modified fertile leaf. In the ontogeny of the legume of two species of *Acacia*, I have found evidence that is contrary to these new interpretations, and is favourable to the classical interpretation. A preliminary

note on the subject is appearing in the current *Proceedings of the Linnean Society of New South Wales.*

In so far as modern theories are applied to a monocarpellary gynœcium such as the legume, the assumption that the carpel is a terminal structure is common to them, though their ultimate conclusions differ. In *Acacia suaveolens* and *Acacia longifolia*, after the petals have been initiated, the conical axis broadens just below the apex into a disc-like structure on which the stamens are formed surrounding the small, central, domed apex. The carpel (legume) is begun by periclinal divisions and enlargement of the cells of the hypodermal layer *at one side of* the small domed apex. The carpel grows out from the side of the apex; but it is forced by the lateral pressure of the tightly packed stamens into an erect position. This process pushes the small suppressed apex to one side, so that, in older stages, the carpel appears to be terminal. *But in its origin it is lateral.* I have selected three photomicrographs (Figs. 1–3) out of many that were available.

Thompson[1] states that the whole of the residual apex gives rise to the legume, for example, in *A. spadicigera*, which he interprets as an axial structure (a phylloclade). Saunders[2], bringing the Mimosoideæ under the theory of carpel polymorphism, refers to

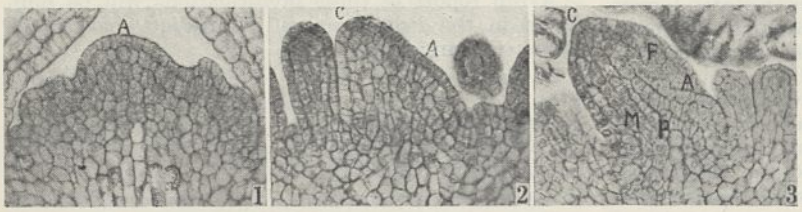

FIG. 1. Longitudinal section of young flower of *A. suaveolens*, from petal insertion upwards. *A*, centre of domed apex. × 200.
FIG. 2. Longitudinal section of young flower of *A. suaveolens*, upper central part only. *A*, original centre of domed apex; *C*, tip of emerging lateral carpel. × 200.
FIG. 3. Longitudinal section of young flower of *A. longifolia*. *A*, original centre of domed apex; *C*, tip of the lateral carpel; *F*, face of the incipient groove in the carpel down which the section passes; *M*, pro-cambium of the midrib; *P*, extension of pith cells between pro-cambium and suppressed apex. × 200.

A. suaveolens and *A. longifolia*. Referring to the legume as terminal, she denies to it a single, leaf-like structure. Gregoire[3] discusses floral primordia, and makes the general assertion that the whole central part of the floral axis becomes, or could become, a carpel. The evidence that is represented by the three figures reproduced herewith is incompatible with the interpretation of the carpel as a terminal structure. Thomas[4] interprets the ovules as terminal structures enclosed by the carpel wall—a cupule-like structure. This cannot apply here for they are borne on the margins of the carpel (legume), which is lateral to a suppressed apex.

In none of the papers referred to are the contentions supported by illustrations of the cellular details of the primordia. If an examination of such details produces evidence so clearly contrary to the new theories in this case, does there not arise grave doubt of the validity of the theories in the other cases?

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Photochemical Reactions of SH-Compounds in Solution

ACCORDING to the literature of all the SH-compounds, only the photochemical decomposition of hydrogen sulphide (in aqueous and hexane solution) has been studied[1].

We have investigated some inorganic and organic sulfhydryl compounds (RSH), for example, NaSH, C_2H_5SH and various thiocarbonic acids (thioglycolic acid, cysteine) in aqueous neutral or alkaline solution by exposing these solutions, which all absorb in a region below 3000 A., to the radiation of a strong mercury arc.

In every case a greater or smaller amount of hydrogen gas was produced with simultaneous formation of the corresponding disulphide compound. We have here most probably the primary process:

$$R\text{SH}+h\nu=R\text{S}+\text{H} \quad . \quad . \quad . \quad (1)$$

In aqueous solution, where a certain amount of the anion (RS$^-$) is present, an electron transfer takes place:

$$R\text{S}^-\,\text{HOH}+h\nu=R\text{S}+\text{H}+\text{OH}^-, \quad . \quad . \quad . \quad (2)$$

followed by

$$2\text{H}=\text{H}_2, \quad 2R\text{S}=R\text{SS}R.$$

The quantum efficiency with respect to the H_2-formation was found always to be considerably smaller than unity. This indicates that reverse reactions are going on, for example, the recombination of the H-atom with the RS radical and the reduction of the disulphide by H-atoms. There has also been observed a splitting of the RSH compound into RH and sulphur, which sometimes becomes very prominent and the mechanism of which is not quite clear.

Many of the SH-compounds were found to be reacting with different fluorescent dyestuffs at a measurable rate in the dark. By irradiating with light which is absorbed by the dyestuff, this reduction reaction is accelerated[2]. Accordingly SH compounds must exert a strong quenching effect on fluorescent dyestuffs. The elementary process of the quenching is then in principle represented by reactions (1) and (2), in which the activated dyestuff replaces the quantum ($h\nu$).

The experiments described above have an interesting bearing on the assimilation of carbon dioxide by sulphur bacteria (for example, *Thyocystes*). With infra-red radiation—which is absorbed by the dyestuff bacteriochlorophyll present in these bacteria—the bacteria are able to reduce carbon dioxide with hydrogen sulphide under anærobic conditions[3].

Whereas the chlorophyll of green plants is able to sensitise the formation of H-atoms from water by irradiation with visible light in the presence of ferrous ions only[4], the hydrogen sulphide (on account of the smaller binding energy S-H) gives off H-atoms with the considerably smaller energies present in the infra-red (in the absence of ferrous ions).

A full account of the results will be published elsewhere.

We wish to express our sincere gratitude to Prof. F. G. Donnan for his great interest and encouragement during this work and Prof. J. C. Drummond for his hospitality.

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Absorption Spectra of Tetra-Alkyl-Ammonium Halides

SOME time ago, Ebert and Lange[1] observed in the course of cryoscopical measurements that tetra-alkyl-ammonium salts R_4NX do not dissociate completely in water, if R and X are heavy enough. These experiments, however, are naturally not able to distinguish between complex formation, pairs of ions kept together by electrostatic forces, and true covalent undissociated molecules. We have therefore measured the absorption spectra of a number of these salts.

We have observed that the heavier ones exhibit maxima of selective absorption at about 270 mμ which are the same for iodides, bromides and chlorides, and which we ascribe to the (hydrated) R_4N^+ ions. Among the heavier salts there exists, however, a remarkable decrease of intensity, the figures for the $(C_5H_{11})_4N$ salts being as follows: Iodide 274 mμ, log $K = 1{\cdot}4$; bromide 274 mμ, log $K = 0{\cdot}6$; iodide (maximum superimposed on the ascent to the maximum of the I^-) ~ 270 mμ, log $K = 0{\cdot}4$. We have therefore measured these spectra again with a precision method, using a recording microphotometer, and find that these maxima, as well as that at 228 mμ belonging to the iodine ion do not follow Beer-Lambert's law exactly, but decrease slightly in intensity in more concentrated solutions, the number of absorbing molecules being kept constant. For both maxima the effect is small but certainly real.

This result appears to suggest, particularly since the maximum at 228 mμ belongs solely to the iodine *ion* and does not change its wave-length, that in stronger solutions there exists an equilibrium between the electrovalent and a true covalent form, and that nitrogen can possess five single covalent links under favourable conditions. The difference between the N–C and the N–I bond will then be only that the latter is more polarised and therefore a transition to the electrovalent form is easily accomplished, just as the AgCl bond is covalent in the vapour state, but electrovalent in solution on account of the additional energy of hydration.

A full report of these investigations will be published in the *Proceedings of the Indian Academy of Sciences* (Bangalore).

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Points from Foregoing Letters

USING radioactive phosphorus as indicator and analysing maize plants at different stages of growth, Prof. G. Hevesy, K. Linderstrøm-Lang and C. Olsen find that phosphorus atoms, present as essential constituents in the leaves of maize, are in a mobile state; a continuous interchange of phosphorus atoms takes place between the leaves during the process of growth.

Mr. H. Ramage directs attention to the results of some of his spectrographical analyses showing the percentage of various elements in different parts of seeds. He suggests that some elements may be present only incidentally in variable amounts in the circulating fluid, while others, present in more or less definite proportion, especially in seeds, are probably essential to life.

An instrument for measuring *in situ* the transparency of sea-water at relatively great depths (500 metres) is described by Dr. H. Pettersson. The instrument has been found useful for the detection of suspended matter due to movements of the bottom layers of water, and also in detecting clouds of organic particles (phytoplankton) which are of great importance for biological studies.

Laboratory experiments on the double-refraction of short radio waves in ionised air, under the influence of a magnetic field, are described by Prof. S. K. Mitra and A. C. Ghosh. The results are in fair agreement with those predicted by theory.

A possible method of determining the amount of heavy hydrogen in the gas liberated during the electrolytic separation of heavy water is discussed by W. C. Newell, R. H. Purcell, H. S. Gregory and Dr. H. J. T. Ellingham. The method is based upon the thermal conductivity of the gas containing the heavy hydrogen gas at a pressure of 10 cm. Hg.

1 : 3 : 5-trideuterobenzene, which possesses interesting symmetry properties from a spectroscopic point of view, has now been prepared from trimesic acid by L. H. P. Weldon and Dr. C. L. Wilson.

A new method of producing polarising metallic mirrors is described by M. Cosyns. Some of these give a polarisation perpendicular to the usual direction.

Dr. I. V. Newman reports that the evidence of the cellular details of the primordium of the legume of two species of *Acacia* is contrary to the recent theories of the carpel enunciated by other workers in this field. The evidence shows the legume to be a lateral organ.

Sulphur bacteria, such as *Thyocystes*, possess a substance similar to the chlorophyll of plants by means of which, under the influence of infra-red radiation, they are able to assimilate carbon dioxide through the action of hydrogen sulphide, in the absence of air. Drs. Joseph Weiss and H. Fishgold describe the behaviour of sulphydryl compounds when irradiated by ultra-violet light, and their reactions with fluorescent dyestuffs; this may help to elucidate the mechanism of the sulphur bacteria.

Research Items

Further Light on Peking Man

SINCE the lamented death of Prof. Davidson Black, further material from Choukoutien has been acquired by the Cenozoic Laboratory, which necessitates a new inventory now in course of preparation by Dr. Franz Weidenreich. In a preliminary report on recent discoveries and reconsideration of earlier material, especially the isolated teeth (*Bull. Geol. Soc. China*, 14, No. 4), Dr. Weidenreich also discusses the important question—as yet unsolved—how the *Sinanthropus* individuals came to the cave of Choukoutien. His conclusions are that the new material —jaws, and fragments of jaws, a fragment of a left humerus and possibly two fragments of limb bones, with a new skull specimen, a well-preserved fragment of a brain case, strongly fossilised, which is of great importance—confirms the fact that *Sinanthropus* represents an independent hominid type, distinctly inferior to Neanderthal, and showing definite anthropoid peculiarities in many features. The teeth exceed in size those of recent and Neanderthal man. Premolars and molars are very complicated in their pattern. The upper canine is long and wide and projects like a tusk beyond the level of the first premolar. The teeth are more variable in size than in a corresponding population of recent man, and a sexual difference must be recognised, like that of the Simiidæ. A "Torus mandibularis"—hyperostoses on the inner side of the alveolar part—in two out of the four adult jaws, as well as the shovel-shape of the teeth, are peculiarities observed in the modern Mongolian race, and suggest that *Sinanthropus* takes his place in the direct line leading to recent man and that among recent races the Mongolian group has the closest affinity to Peking man.

Roman Fort at Brough, East Yorkshire

EXCAVATIONS in the Bozzes Field, Brough, which were begun in 1933, were continued in 1934. In a report on the results by Mr. Philip Corder (Hull Museum Publications, No. 185—Reprint from *Trans. E. Riding Antiq. Soc.*, 28, 1), it is stated that the objective of the season's work was to trace the suggested line of the southern defences, to define the line of the northern defences, and to collect further evidence of date. The attempt to find the southern line of defence was not successful, the supposed line of ditches being found to be either small local ditches around huts, or shallow pits. These attested a poor occupation extending from a date not later than the seventies of the first century, and probably earlier, up to the end of the fourth century. Here characteristic pottery of the Signal Station type was found; but none occurred in the north half of the field, or in the cut across the east defences in the south-east corner. The late occupation would appear to be confined to the south-west corner of the field. The earliest occupation was clearly very extensive. Flavian sherds were everywhere encountered in the lowest levels. Some vessels appear to be pre-Agricolan, as may also be the 'stabbed' ware, of which sherds occurred in the earliest levels in several places, as this cannot be paralleled on any known Agricolan sites. It is a Roman ware, and if of local manufacture, as seems probable, presupposes an occupation long enough for the establishment of kilns. This corroborates the early date suggested for the first occupation, though this can no longer be regarded as necessarily military. So far as the evidence goes, the east rampart appears to belong to a date not earlier than Trajan; while a rectangular bastion on the east wall may be of late third century date. Certain possibilities suggest that the site was a fortified town rather than a military station.

Huntington's Chorea

CHOREA, or St. Vitus's Dance, is a disease characterised by aimless and involuntary spasmodic muscular contractions affecting the face and limbs, and is commonly met with in children, is associated with rheumatism, and generally terminates in recovery. There is, however, another form known as 'Huntington's chorea', so called after George Huntington, who in 1872 gave the first account of it, which led to the naming of the disease after him; it is hereditary, generally affects adults, and is progressive. This disease forms the subject of a monograph by Dr. Julia Bell in "The Treasury of Human Inheritance" (4, Pt. 1. Cambridge University Press, 1934. 10*s.* net). In 460 cases, collected by Dr. Bell, the mean age of onset was 35·5 years, few occurring before 15 or after 55 years. The disease behaves genetically as a dominant, in the sense that it is transmitted directly from parent to offspring, and hence is sometimes known as 'hereditary chorea'. In the pedigrees of 991 cases investigated, there is no significant difference in incidence in the two sexes. The average duration of the disease in 204 cases was 13·72 years, though in individual instances it is not incompatible with a long life. The most serious complication is progressive mental deterioration, and some fifty per cent of males and seventy per cent of females end their days in asylums. The pathological basis of the disease appears to be atrophy of the ganglion cells and increase of glia in the caudate nucleus and putamen of the corpus striatum, with involvement of the brain cortex when mental deterioration ensues. The genetic basis of Huntington's chorea may lie in some inherent defective vitality of the cells affected in the striatum. A full bibliography and pedigree plates of 151 cases are appended to Dr. Bell's monograph.

Sea-Snakes

MALCOLM SMITH, reporting on the sea-snakes (Hydrophiidæ) of the Carlsberg Foundation's Oceanographical Expedition round the World, 1928–30, and previous *Dana* Expeditions (*Dana* Report No. 8, 1935), finds the collection of considerable interest although small. Many of the specimens were met with in areas from which no sea-snakes have previously been obtained, for the difficulties of capturing them from vessels when at sea is great, and the bulk of the material upon which our knowledge of this group is based has been obtained in coastal areas. More than half the specimens, and examples of nearly all the species mentioned, were netted after dark, being attracted to the side of the ship by lantern light. Probably they feed chiefly during the night, and the

vast numbers that may be seen on calm days at the surface of the ocean are merely resting there or basking in the sun. With the exception of *Pelamis platurus*, which, owing to its pelagic habits, has gained a wider range than the others, the distribution of the family Hydrophiidæ extends from the Persian Gulf along the coasts of Asia to Japan, and thence southwards and eastwards through the East Indian Archipelago to Oceania, the known limit of range with certainty in that direction being the Samoan Islands and Savage Island (lat. 170° W.). The sea-snakes are divided into two sub-families, very different from one another both in morphological characters and habits, and it is reasonable to assume that they have had an independent origin, the Laticaudinæ, the more primitive, in the Australian and Papuasian region, the Hydrophiinæ in the Oriental. A new species, *Hydrophis parviceps*, is described. The type and only specimen, an adult male, was caught by night off the coast of Cochin China.

The Cape Crawfish

FISHERY BULLETIN No. 1, Department of Commerce and Industries, Fisheries and Marine Biological Survey Division, Union of South Africa, 1935, consists of an interesting paper by Cecil von Bonde and J. M. Marchand, "The Natural History and Utilisation of the Cape Crawfish, Kreef or Spiny Lobster, *Jasus* (*Palinurus*) *lalandii* (Milne Edwards) Ortmann". The Cape crawfish has been used for a long time as the basis of a large industry, and its importance makes it imperative to know something of its anatomy and life-history, which are here well described. Experiments on feeding show that fresh food in the shape of shell-fish, chiefly mussels and their relatives, is the natural food, although when food is scarce it will eat almost anything. The crawfish lives on rocky bottoms, where seaweed is plentiful; but may also be found on sand, in which case the colour is much lighter. The smaller specimens, apparently still young, are confined to shallow water, and, as they grow older, they migrate into greater depths. Tagging experiments are at present in operation by means of a small brass label attached by a wire to the basal joints of the antennæ. From a preliminary trial it is found that considerable movement takes place. It is well known that local migrations occur just before or just after the casting of the shell, in every case the movement being apparently towards areas affording maximum shelter and protection during the soft shell period. Part 2 deals with the industrial side of the question, history of the industry, canning, marketing, boats and equipment, methods of fishing, fishing grounds and protective legislation.

Development of the Pectoral Limb of *Necturus*

HSIN KUO CHEN (*Illinois Biol. Mon.*, 14, No. 1 (1935)) points out that previous work on the development of the chiropterygious type of limb has been directed along three lines: (1) whether in the formation of the primordial limb-bud the myotomes take part either in the form of processes or of cell-migration, or whether the limb arises as a thickening of the somatopleure and is in no way derived from the myotomes; (2) the analysis of the factors which determine the differentiation of the limb-bud, the change of symmetry and the formation of the nerve-plexus in transplanted limbs; (3) whether the muscles are arranged, as Romer suggested, in two groups, one dorsal (dorso-medial) and one ventral (ventro-lateral) which may be homologous with, or derived from, the two opposed masses of muscles present in the paired fins of fishes. The author has investigated the development of the pectoral limb in the embryos and larvæ of *Necturus maculosus*. The primordial limb-bud arises in the embryo of 9 mm. as a thickening of the somatopleure before the appearance of the ventral myotome-processes; these appear in the 10 mm. embryo and grow downward towards the limb-region. There is no indication of a migration of cells from these processes to the limb-bud, and the isolated myotome-processes are finally transformed into the muscles of the ventral body-wall. The growth of the limb-skeleton and the formation of the brachial plexus are traced. The limb-muscles arise as dorsal and ventral masses of condensed mesenchyme cells in the embryo of 16 mm., and their mode of development suggests that the limb-musculature of tetrapods originated from the opposed muscle-masses of the paired fins of fishes.

Importance of the Gastropod Protoconch

IN his "Studies of Gastropoda" (published by the National University of Peking, 1935) Prof. Amadeus W. Grabau emphasises the significance of the embryonic whorls in the gastropod shell and their importance in studying phylogeny. The work is in five chapters, each separate in itself and having already appeared in other publications; but all hang together and make an interesting volume. The gastropods chosen are both recent and fossil, and in some cases reference is made to the veliger stage and its shell, but most of the work depends upon the shell alone and its apex. It is now known that many marine gastropods may spend some time as free-swimming larvæ and that the larval shell shows the period of planktonic life. Similarly, those which have no free-swimming stage but hatch without a velum show the embryonic shell at the apex. Except in those cases in which the tip breaks off in the adult, this apex is extremely important in showing relationships of the various forms, and much may be learned from its study. Most of the examples chosen come from China, and there are many illustrations. Chapters i–vi deal with the characters of the gastropod shell; *Fulgur* and *Sycotopus*; orthogenetic variation in Gastropoda; the value of the protoconch and early conch stages in the classification of Gastropoda; and the significance of the so-called ornamental characters in the molluscan shell.

Control of the English Oak Scale in New Zealand

AMONG the most recent reports on biological control in New Zealand is that by Mr. E. S. Gourlay (*N.Z. J. Sci. and Tech.*, 16, 216–35 (1935)) with reference to the golden or English oak scale (*Asterolecanium variolosum*). This pest often occasions such extensive injury to *Quercus pedunculata* in the Dominion that old trees are deformed and stunted, while young trees may be killed. The scale was probably accidentally introduced, in the early days of settlement, when many trees were taken over from England by colonists. It has also become established in the United States, where, in association with it, the Chalcid parasite, *Habrolepis dalmanni*, has become common. A consignment of *Habrolepis* was dispatched from Massachusetts State to New Zealand in 1923; this was followed by seven other consignments, the last arriving in 1928. After intensive

breeding at the Cawthron Institute, Nelson, supplies of the parasite were dispatched to other localities. There is no doubt that the species is now well established, but it has taken twelve seasons of work, attended by several failures, to bring it up to its present status in relation to its host. In the Nelson area it parasitises the oak scale to an average of more than 59 per cent while, in a much shorter period at Christchurch, the average parasitism is given at 30·7 per cent. There is every reason for believing that the percentage of parasitism will increase up to a point when its host will no longer be looked upon as a pest in New Zealand.

Tectonic Lines in the Philippines

THE REV. W. C. REPETTI, whose studies on the distribution of Philippine earthquakes have already been referred to in NATURE of March 5, 1932, p. 367, has recently mapped the principal tectonic lines in the islands, partly by the trend of the surface features, chiefly by the linear arrangement of earthquake epicentres (Manila : Bureau of Printing. 1935). The shorter lines, nine in number, are mostly submarine and lie to the north and west of Luzon and one in the eastern part of Mindanao. The principal line, called by Father Repetti the "master fault", is probably not less than 350 miles in length, and is thus comparable in magnitude with the San Andreas rift in California. Towards the north, it begins in an epicentre off the west coast of Luzon, then traverses the island in a south-easterly direction, following the fault-scarp that bounds the mountains of northern Luzon to the south and a rift valley eighteen miles in length. After this, its course is mainly submarine, but running parallel to a series of inactive volcanoes, until it ends in an epicentre near the middle of Mindanao.

Seismographic Study of a Great Explosion

A BLAST of 45 tons of blasting powder, distributed in pockets along a line 233 ft. long, was fired in a quarry near Richmond, Cal., on August 16, 1934, the weight of rock moved being about 400,000 tons. The shock was registered by Wood-Anderson seismographs at six stations, one of which (Mount Hamilton) is 94·4 km. from the quarry. The resulting seismograms have been studied by Messrs. P. Byerly and J. T. Wilson (*Bull. Amer. Seis. Soc.*, 25, 259–268 (1935)). The travel-time curves indicate one P wave in the upper layer, of Franciscan formation, travelling with a velocity of 4·3 km. per sec., and another, with a velocity of 5·4 km. per sec., in the underlying medium, which may therefore be identified as granite. They show also that the average thickness of the upper layer in the San Francisco region is about one kilometre.

Deep Oil-Well Drilling

IN the course of sessions held during the annual meeting of the American Petroleum Institute at Los Angeles, emphasis was laid, according to Science Service of Washington, D.C., on the difficulty now being experienced by engineers who are called upon to sink wells to a depth of 10,000 ft. or more. At such extreme depths, high pressures are encountered, and great ingenuity is required to obtain strong enough pipes to withstand them. Obviously the thicker the wall of a pipe the greater is its strength, but thickness cannot be increased indefinitely, since thick pipes necessitate large bore-holes which become uneconomic at great depths. At the present time, 95,000 lb. per square inch pressure resistance is required for wells more than 10,000 ft. deep, and this is only achieved by compressing large steel pipes into a smaller finished circumference.

Gasolene Losses from Storage Tanks

THE Division of Research Information, National Research Council, Ottawa, has issued a report on evaporation losses from gasolene storage tanks under the influence of the sun's rays. The subject is of particular interest, in that official statistics show that in 1934 the amount of crude oil, gasolene, fuel oil, kerosene and lubricating oil in storage in the Dominion approximated 500,000,000 gallons. Statistics of total losses sustained through evaporation from storage tanks are not available, but are recognised as being considerable. The report claims that two-thirds of these losses can be eliminated by reducing to a minimum the area of the tank exposed to the sun's rays and coating the surface with aluminium paint or other material having a high reflecting power. An even greater proportion can be avoided by insulation, which reduces to a minimum the variation of temperature over the surface of the tank. Finally, in large refineries more expensive systems of cooling and trapping the vapours can be employed to advantage. The report includes valuable data of the effect of the sun's rays on horizontal and vertical surfaces.

Thermal Stability of the Lower Atmosphere

A. L. HALES (*Proc. Roy. Soc.*, *A*, Oct. 1) has investigated the thermal stability of the atmosphere, following the investigations of the stability of a fluid heated from below, made by Rayleigh and by Jeffreys. The transfer of heat in the atmosphere is mainly by turbulent motion, and molecular conductivity can be neglected in comparison with this. An equation is obtained for the turbulent conduction under various conditions. It is shown that the temperature may lapse with altitude more rapidly than in adiabatic equilibrium over limited regions of the atmosphere (of the order of 100 m. thick).

Electronic Charge Collected by Falling Drops

C. T. R. WILSON has suggested that water drops may collect a charge by falling through a region containing charged small droplets of mixed sign subject to a vertical electric field. If the mobility of the droplets is small, and the field be taken to be of positive potential gradient, the downward-moving positive droplets do not move fast enough to overtake the drop. The positive droplets which are met by the drop are repelled from the induced positive charge on its lower half, and the drop collects a net negative charge from the droplets which it overtakes. When it acquires a negative charge, it attracts some of the positive droplets which it overtakes, and an equilibrium is set up in which the net negative charge is some fraction of the induced charge. J. P. Gott (*Proc. Roy. Soc.*, *A*, Oct. 1) has tested this mechanism experimentally. He produced a cloud by cooling a mixture of steam and air, and charged the droplets by exposing them to X-ray ionisation in an electric field. He then allowed large water drops to fall through the cloud in a field of about 1,000 volts/cm. The drops were collected in a Faraday cylinder and the charge collected. The sign and approximate value of the charge were in accordance with Wilson's theory.

Seventh International Congress of Mining, Metallurgy and Applied Geology

THE seventh of the series of International Congresses on Mining, Metallurgy and Applied Geology was held in Paris on October 20–26, under the presidency of Dr. Leon Guillet, and with the support of a number of French technical institutions. Those attending the conference numbered no fewer than 1,500, the majority of whom represented the various mining and metallurgical interests of France, but more than four hundred of the visitors came from other European countries and from the British Empire.

At the opening ceremony, which was held in the Sorbonne, the President of the French Republic, M. Lebrun, addressed the gathering, while the presence of Prof. Henri le Chatelier, in spite of his advanced age, was particularly gratifying to the metallurgical section of the delegates. In the course of a striking speech, Prof. le Chatelier pointed out that the papers fell naturally into two classes, those of the research type and those of a technological nature, and referred to Bacon's dictum that "to order Nature it is necessary to obey her laws". To obey those laws, added Prof. le Chatelier, it is first necessary to know them.

Comparatively few were present from Great Britain, but these included Sir Robert Hadfield, representing the Iron and Steel Institute, Dr. Harold Moore, representing the Institute of Metals and the British Non-Ferrous Metals Research Association, and Dr. Richard Seligman, also representing the Institute of Metals. Sir Robert Hadfield, in the course of a brief address, referred to our great indebtedness to French men of science and technologists, and offered, on behalf of the Iron and Steel Institute, heartiest congratulations and good wishes for the success of the congress.

In all, some 360 papers were presented before the three sections of the congress, the heavy programme being completed in the time available by the subdivision of the principal sections and the holding of separate meetings to discuss related groups of subjects. The Mining Section, under the presidency of M. Taffanel, discussed a number of general questions concerning the exploitation of deposits, the equipment of mines, and the organisation of labour. The petrographic study of coal formed the subject of several communications, while flotation problems also received considerable attention.

Progress in Metallurgy

Prof. A. Portevin presided over the Metallurgical Section, which comprised some 400 members, and discussed 120 papers. These ranged over a wide field and dealt with ferrous, non-ferrous and general matters. The light alloys of aluminium and magnesium received much attention, while copper alloys, corrosion problems, and the mechanical properties of alloys also formed the subjects of a number of papers. The foundry sub-section was in the hands of the French Foundry Technical Association, which had this year merged its annual conference with the congress, and a number of interesting and valuable papers dealing with foundry practice were presented for discussion.

One of the first papers to be read to the Metallurgy Section was contributed by Sir Robert Hadfield, on "Recent Progress in Special Steels", in which the author reviewed the many important uses of alloy steels and emphasised the great savings which had been brought about by their discovery and employment. Other contributions from Great Britain included a paper by D. J. Macnaughtan and Prof. B. P. Haigh dealing with the mechanical properties of tin base alloys, a discussion of the production and properties of oxide coatings on aluminium by Gwyer and Pullen, and an account of the advantages of the drop corrosion test by Dr. U. R. Evans. Other communications dealing with corrosion problems included a report on the work of the French Committee on the Corrosion of Metals for Aircraft; the aspects of its work described by the committee included the standardisation of tests and nomenclature, electrolytic behaviour and passivity of nickel, dissolution potentials of the light alloys, the aluminium-magnesium solid solutions, intercrystalline corrosion and protective coatings. A review of the action of various agents in inhibiting attack on aluminium by electrolytes was also presented by Dr. H. Rohrig.

The preparation and properties of the pure metals were represented by two papers contributed by Dr. R. Gadeau on the production, properties and uses of pure aluminium, and on the production and application of beryllium and its alloys. The extraction and refining of nickel were described in a paper by J. F. Thompson, while L. Andrieux presented a paper dealing with the electrolytic production of boron and its alloys, with particular reference to the author's electrolytic process.

In the Foundry Sub-Section the subjects discussed included special cast irons, malleable cast iron, sand control, the mechanical testing of cast aluminium alloys, the heat treatment of cast magnesium alloys, the present position of pressure die-casting and the casting of nickel-silvers.

An important contribution to the study of heterogeneity in metals and alloys was made by Prof. A. Portevin and M. P. Chevenard, who put forward a classification of the different types of heterogeneity and their origin, and gave details of heterogeneity in various states of heat treatment and working of a series of alloy steels as obtained by a study of the Curie point. The authors have defined an index figure of heterogeneity, and put forward the view that its effect on properties is greater than is usually supposed.

An interesting and valuable paper dealing with single crystals of metals was presented by Schmid, who stressed the value of work on single crystals in connexion with crystal lattices, the mechanism of crystal transformations, physical properties along the various axes, plastic deformation, work hardening and fatigue, the decomposition of supersaturated phases and the properties of polycrystalline materials. The mechanism of recrystallisation, with particular reference to the nature of centres of recrystallisation and of primary and secondary recrystallisation, was

discussed by van Arkel, while Prof. Carl Benedicks gave an account of the applications of microchemistry to the study of slag inclusions, segregation, corrosion and general analytical work.

Recent advances in welding methods and applications were discussed by Granjon and Brillie, while a further paper, dealing with the welding of aluminium and its alloys, was contributed by J. Douchemont.

Applied Geology

Under the presidency of M. Cayeux, the Applied Geology Section held discussions upon a wide range of papers dealing with sedimentary and alluvial deposits. A number of these communications were devoted to the geology of the French North African colonies, which are particularly rich in a variety of metallic ores, most of which are unfortunately unexploited, although the cobalt deposits of Bou-Azzer are being fully developed and also contain valuable auriferous minerals.

The influence of geological studies upon the execution of public works was another subject discussed by this section of the congress. In the construction of dams, railways, roads and even buildings, it was pointed out, it is of great importance to have precise information as to the nature of the ground where these works are being undertaken. The increasingly important part played by geology in agriculture was also brought out in the course of a further paper contributed to this section.

Recent geophysical research work was also described, with particular reference to electromagnetic prospecting by low-frequency alternating currents. Regional studies were also described, dealing with prospecting in Alsace, and magnetic anomalies in Madagascar and north Java.

The importance of geology in the exploitation of natural resources necessitates the establishment of an organisation for dealing with research and information, and to these questions the congress gave some consideration, dealing specifically with applied geophysics, the geology of petroleum, the preparation of geological surveys and the prosecution of researches on mineral deposits.

One other feature of the congress was an interesting exhibition of testing equipment arranged in the Ecole Centrale des Arts et Manufactures. Visits to manufacturing and scientific centres were also arranged for the visitors.

This large-scale conference was undoubtedly a triumph of organisation and hospitality, and those attending were welcomed with the utmost friendliness by their French hosts.

Progressive Teaching in Geography

Geographical Association

THE annual Conference of the Geographical Association was held at the London School of Economics on January 1–3 under the presidency of Mr. James Fairgrieve. Mr. Fairgrieve retired at the end of last session from the readership in education with special reference to the teaching of geography, which he has long held at the Institute of Education (University of London), and in what he described as the 'Swan Song' of his teaching career asked the question "Can we teach geography better ?" In the course of the careful reasoned answer to his own question, he suggested that teaching is essentially the giving of the opportunities to learn. Whilst boys and girls are contrasted mentally as much as they are physically, the same three stages are apparent in each : the wonder of the child ; the realism of the boy, and the idealism of the youth or adolescent. The mental diet must be carefully suited to each stage ; to serve mental beefsteaks to the child is as stupid as teaching a caterpillar to fly—a function which belongs naturally to a later stage in development. The teacher who destroys the natural wonder of the child is committing a crime closely akin to murder. Mr. Fairgrieve urged strongly the desirability of teaching small children by means of vivid examples, leaving 'logical sequences' of knowledge to the third stage. Whilst every thinking teacher will admit the wisdom of this, Mr. Fairgrieve perhaps overlooked the supreme importance of logical thinking on the part of the teacher in the selection of good examples.

Mr. Ernest Young, the other half of the internationally famous combination of 'Fairgrieve and Young', lectured on a voyage round the world by cargo boat, and in a series of delightful word pictures supplied just those vivid examples of life in varied parts of the world which his colleague had urged should be used in infant teaching.

The Association devoted a morning session to the subject of soils. Dr. W. G. Ogg, director of the Macaulay Institute for Soil Research, Aberdeen, dealt with the soils of Britain and their classification. He showed clearly that whilst certain soil types, for example, podsols, are clearly defined and recognisable, many British soils are 'skeletal' or 'immature' ; over the whole of lowland Britain the classification of the 'brown soils' is a matter of extreme difficulty, since these soils owe their characters in large measure to the processes of cultivation, and the normal sequence of soil development has been profoundly changed. It is thus possible to indicate on a map where certain soil types occur, but present knowledge makes it impossible to attempt more than a hypothetical soil map of Britain. Dr. S. W. Wooldridge, in a contribution entitled "Practical Soil Studies for Geographers", urged that texture has played a very important part and is a characteristic of soils which can be studied by the geographer. He introduced a simple and ingenious diagrammatic way of representing a physical analysis and showed the relationship of certain crops to soils with different physical characters. Dr. L. D. Stamp, dealing briefly with the utilisation of British soils, urged that the geographer should make his own contribution to the subject by mapping and recording details of land use, determining or defining minor land use regions, and then ask the soil scientist for his help in explaining the phenomena observed. This, he suggested, is a more valuable approach than any attempt to enter the pedologist's own sphere.

Dr. E. B. Worthington lectured on a biologist's view of Africa, and Dr. H. J. Wood, who has recently returned from a year's study in the United States,

on irrigation in the western part of that country. He dealt with economic aspects and drew an interesting distinction between the economically sound schemes in California and the south, and the schemes undertaken for political reasons farther north where farming is handicapped by a short growing season.

Numerous papers and discussions dealt with varied aspects of the teaching of geography, and a joint session was held with the Le Play Society. An extensive exhibition of maps was arranged by the Land Utilisation Survey of Britain; the results of the Survey have now been edited and the one-inch maps prepared for nearly half the country; the number of published sheets is now thirty.

The president and the council of the Royal Geographical Society were the hosts at a reception at Kensington Gore, and the thanks of the Association were expressed by the new president, Sir Josiah Stamp.

Institute of British Geographers

The Institute of British Geographers held its third annual meeting at the London School of Economics on January 2–3. In the opening paper, Mr. S. H. Beaver (London) analysed the growth of the Bulgarian State Railway system, evaluating the relative importance of political, economic and physical factors in its gradual evolution. By means of an excellent series of maps, the traffic on the railways—mainly lignite, wood and agricultural produce—was used to show the present trends in economic development. In his paper on the economic geography of wheat, Dr. R. O. Buchanan (London) demonstrated the outward movement of the geographical margin of production during the War and post-War periods of rising prices. With falling prices, especially since 1929, the natural tendency has been towards a reduction of area and a retreat of the margin of cultivation from the poorer lands, but this has frequently been hindered by political action.

In an important paper on the evolution of shoreline curves, Mr. W. V. Lewis suggested that the action of longshore currents has been greatly exaggerated, and that the curves of shingle beaches in particular are closely related to the direction of wave approach. The largest storm waves seem to play the most important part, but the smaller waves of calmer weather also play a considerable part. The examples analysed are those where both large and small waves alike approach from one narrowly defined direction —as in the Christchurch, Poole, Weymouth and Lyme Bays of the English Channel—and it is found that the shingle beaches form long sweeping curves at *right angles* to the dominant wave direction. The importance of Mr. Lewis's conclusions was agreed in the discussion which followed the paper, and Mr. D. L. Linton (Edinburgh) mentioned experiments in a trough which confirm the general theory.

Mr. A. Stevens (Glasgow), in a paper entitled "Geometrical Geomorphology", urged that the majority of the topographical and structural features of the globe follow rectilinear courses which are either great circles or secondaries of great circles, and attempted to show that the structure lines may be related to a tetrahedral scheme.

Mr. W. G. East (London) urged the use by geographers of the mass of information contained in the semi-official agricultural surveys of the counties of Britain which were initiated by the newly formed Board of Agriculture in the 1790's. He showed reproductions of a number of the soil and land utilisation maps, and indicated their use in comparison with the maps of the present Land Utilisation Survey now in course of publication. In the discussion, the Director of the Survey mentioned how often a comparison of the maps supports the generalisation that on the best and the poorest soils of the country there has been comparatively little change in land use; the great changes have taken place on soils of intermediate quality or fertility—land which it may pay to work as arable land only in periods of economic prosperity.

Dr. R. A. Pelham (Birmingham) presented a study of the distribution of population in England in the fourteenth century based on the enrolled Poll Tax returns of 1377 and on an analysis of parliamentary representation throughout the century. The figures available do not permit the construction of an absolute population map, but show clearly areas of relative heavy density—the agricultural counties of the East Midlands and East Anglia. Among towns, London (with 30,000–40,000 people) was already larger than the four towns next in size combined—York, Coventry, Bristol and Plymouth. L. D. S.

Science Masters' Association

Annual Meeting

THE thirty-sixth annual meeting of the Science Masters' Association was held on January 1–4 at the Chemistry Department, Imperial College of Science, South Kensington, with evening meetings at King's College of Household and Social Science.

At the opening meeting, which was attended by nearly four hundred members, the presidential address was given by Sir William Bragg, his subject being "School Science after School". Sir William, contrasting the state of school science to-day with its condition fifty years ago, asked whether our science boys are doing well for themselves and for the community, and whether any efforts on our part could help them to do better. In these days, scientific knowledge and the application of scientific knowledge grow at a rate which takes everyone by surprise. Sometimes our new powers are turned to excellent advantage; sometimes they fall into hands that use them with deplorable effect. Science has become highly important in the life of the nation. But, at the same time, the nation is beginning to think more and more of itself as a family in which each one is responsible for the welfare of the others. Scientific workers must do what they can to help in solving the many problems that distress and perplex mankind.

Sir William pleaded for a place for science in the team which should work for a common end, namely, to guide the nation and guard its welfare. We must be specialists, but not specialists only. To make a

strong fabric of the State, our various specialities must overlap and intertwine like the fibres of a woven cloth. The strength of the fabric depends upon that overlapping: indeed the strength of the single fibre depends on the overlapping of the separate crystallites.

Our scientific workers should be well able to use their native tongue, well able to arrange their thoughts, arguments and conclusions, and to put them into language that will be understood. The ideal ruler of Plato's State was to be versed in all that he called philosophy, including science, music, physical culture, the arts of war, and above all, the pursuit of that which was good. To-day there is no such super-man. But it is possible to include in the national team all those excellencies, distributed over many individuals. The one thing necessary is that they should appreciate each other's point of view and mode of thought.

Prof. J. V. Philip lectured on "Chemical Fogs" and intrigued his audience with his speculations as to the effects of ammonia on the incidence of fogs. Prof. J. W. Munro spoke on recent advances in economic entomology and pointed out that the tendency to-day is to emphasise the importance of the zoological aspect. In fact, the economic entomological problems are really one zoological problem, namely, that of the fluctuations in insect numbers and their causes.

Dr. John Taylor greatly interested the Association by showing how science assists the forces of the law, and Dr. H. J. T. Ellingham elucidated the intricacies of the "Simple Cell". Mr. H. R. Hewer showed a selection of biological films produced by Gaumont-British and directed by himself with the assistance of Prof. Julian Huxley. Some of these were quite new and had not previously been shown: their excellence was freely commented upon. Mr. B. K. Johnson demonstrated some lecture experiments in optics, including a model eye for showing defects of vision and their remedies.

The members themselves took part in three meetings devoted to discussions: the subjects dealt with were "Laboratory Design and Equipment", "Sign Conventions in Geometrical Optics" and "School Certificate Biology". All of these were well attended.

At the business meeting, the following elections took place: *President*, Prof. J. S. B. Stopford; *Secretary*, S. V. Brown (Liverpool Institute); *Treasurer*, B. M. Neville (William Ellis School); *Annual Meeting Secretary*, R. E. Williams (Repton); *New Members of Committee*, J. L. Brereton (Cambridge), W. Ashhurst (Stretford Grammar School), W. G. Greaves (Ledbury Grammar School) and H. G. Lambert (Moseley Secondary School). Prof. J. H. Priestley, of the University of Leeds, and Mr. F. B. Stead were elected honorary members. The annual report showed that the Association has now more than 2,000 members and that branches in Yorkshire and East Anglia have been formed during the year.

The annual meeting for 1937 will be held in Manchester under the presidency of Prof. J. S. B. Stopford.

Culture and Education among the Modern Eskimo of Alaska*

AS the result of a proposal made by Mr. Wm. John Cooper, Commissioner for Education of the United States, at a meeting of the Council for Education in 1929, and with the financial assistance of the Carnegie Corporation of New York, an investigation covering a period of two years was undertaken among the natives of Alaska for the purpose of examining conditions in the system of education, and suggesting modifications, if any, necessary to bring it into greater harmony with the racial character and probable future development of the Eskimo.

Alaska was acquired by the United States in 1867, and the natives—Eskimo, Aleuts and Athabascan Indians—were brought under the control of the Board of Education in 1887, since when the system of education applicable to the United States as a whole has applied to them. On his appointment as Commissioner for Education in 1929, Mr. Cooper proposed to establish a Division of Indigenous Peoples, under which each people should be treated in accordance with its needs. The present investigation was a part of that proposal. It was entrusted to members of the School of Education of Stanford University; but Mrs. Anderson, who accompanied the expedition in the field, had had experience in the application of the Stanford-Binet intelligence tests.

The method of investigation was (1) to compile as complete a picture as possible of the physical characters, demography and culture of the Eskimo when first encountered by whites, from the records of early travellers; (2) to investigate and record the same features among the Eskimo of the present day from personal observation in the field and contemporary records of anthropologists and others; (3) to inspect existing methods of education with special reference to their efficiency and suitability to the needs and character of the culture of the modern Eskimo; and (4) to endeavour to form an estimate of the trend of development for which provision should be made in educational and administrative policy.

The general trend of change in culture is perhaps best indicated by the recommendations which deal with the economic and social position. It is probable that the native population will increase rather than decrease. Tribal fusion will take place. This movement is already in progress, but it is hampered in some degree by the language difficulty. This will be overcome as the use of English spreads. The settlement in villages, which is at present taking place, will be accelerated. The native type of house, already dying out, will disappear. Where no hardship is involved by the removal from traditional fishing and hunting grounds, the tribes might be settled in villages, giving them the advantage of the better sanitation of the European type of house, especially if built on an improved plan with better methods of heating, such as the use of coal. Village club houses should be built to take the place of the old group *kashgii*. Village councils and co-operative enterprises should be fostered, the latter as a protective measure against the competitive economic methods of the white

* Alaska Natives: a Survey of their Sociological and Educational Status. By Dr. H. Dewey Anderson and Prof. Walter Crosby Eells. Made under the auspices of the School of Education of Stanford University at the request of the United States Office of Education, supported by a Grant from the Carnegie Corporation of New York. Pp. xvi+472. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1935.) 22*s.* 6*d.* net.

population. Whites not actually engaged in activities promoting the life of the native community should not be allowed to reside in the native settlements. The social status of the increasing number of half-breeds should be protected.

In the investigation of the existing system of education, which has been organised entirely on the model of the American school system, administration, staff, buildings, as well as the character and attainments of the scholars, were inspected. In the testing of the scholars, both intelligence and attainment tests were applied.

In the intelligence tests, 45·8 per cent of a school enrolment of 2,302 were tested, of whom 57·2 (651) were counted as of pure blood. Mental, physical and mechanical ability were tested. So far as possible, adaptations in the tests were made to meet the difficulties of environment and language. The results of the Stanford-Binet tests gave an intelligence quotient of:—Eskimo, mean 73·67, standard deviation 12·78; Aleut, mean 80·27, s.d. 13·94; Indian, mean 78·98, s.d. 14·94 (White = 100). This places the Eskimo at slightly above the American Indian and at about the same level as the southern Negro; but in view of the absence of white contacts, it is probable that the Alaska figures represent a slightly higher level than those with which they are compared. It is interesting to note that whereas the intelligent quotient shows a tendency to increase with an increase in the amount of white blood in the subject, it decreases with an increase in the amount of school attendance.

In the physical tests, visual and auditory acuity show little difference from American white children.

In the detailed investigation of results obtained in the subjects of the curriculum, inferiority was shown in all classes of school, Eskimo, Aleut and Indian. This, however, must not be taken to argue inferior ability, but is rather the result of a thoroughly unsuitable curriculum. As an example in the calendar observances, on Arbor Day, the children of a treeless land are concerned with the planting and cultivation of trees and the implements used therein. As a whole, the curriculum is condemned and its modification recommended so that it may be no longer 'subject-centred' as at present, but may be concerned with "activities fundamental to the economic and social life and well-being of the natives".

Forest Products Research in Great Britain*

THE report of the Forest Products Research Board for 1934 has been recently issued. With the report is the annual report of the director of forest products research, 1934. The Research Board met twice during the year. At its first meeting, the Board undertook a general revision of the programme of research of the Laboratory, the effect aimed at being to secure a greater elasticity in the working of the various projects. The second meeting held at the Laboratory enabled the members of the Board to visit the various sections, and to study the progress being made. Two important questions which have engaged the attention of the Board have been connected with, first, the provision of means of closer contact between the work of the Laboratory and timber-using industries and growers in the north of England and Scotland; and secondly, the development of research into problems connected with woodworking. The report states that full advantage has been taken of the facilities offered by the Laboratory for investigating the properties and working qualities of timbers from various oversea units of the Empire.

The director's report deals with the experiments connected with the working or seasoning of more than fifty species of timber so as to remove the cause of badly fitting doors and windows, research in the utilisation of home-grown timbers, experimental work with the cricket-bat willow and research work into the death-watch beetle and other insect pests, and into dry rot and other fungal attack. The report alludes to two important problems which are facing, and will face the new afforestation work in Great Britain. These are connected with, (1) the effects of pruning trees on the quality of the timber, and (2) the utilisation of thinnings. The practical and economic possibility of producing higher grades of timber by pruning standing trees is a question of the first importance to foresters and timber growers. The sylvicultural aspects of this problem are being studied in the field by the Forestry Commission in a comprehensive working plan, and the Laboratory is examining the results of pruning. These latter cover the rate at which occlusion takes place and the extent of grain disturbance, and also the improvement in grade that may be expected in lumber from trees pruned at various ages and to different heights.

Arrangements have been made for the continuation of this work during 1935.

It is well understood by foresters that the best quality of timber is produced by keeping the young crop of trees dense so as to engender clean growth of the young stems, the branches being killed owing to the close overhead canopy. In planting work, this means a large number of plants to the acre. The pruning experiments have for their object the reduction of the initial planting costs through wider spacing of the young trees.

In connexion with the utilisation of thinnings, the report states that the manufacture of pulp and wallboard appears to offer one solution, and preliminary steps have been taken to determine whether industries can absorb the thinnings. In collaboration with an important pulp-grinding firm, and with timber-growing bodies, an investigation is being made into the suitability for pulping of home-grown timber from different localities and grown under different conditions. This project is also being continued.

The Forestry Commission has now planted some 250,000 acres of young woods. The formidable task of commencing the thinnings of the older age classes in this large area is beginning to loom on the horizon as a problem of increasing importance. The problem is a two-headed one, consisting of the correct sylvicultural operation to be carried out in the woods, and the subsequent disposal of the material taken out, at a satisfactory price.

* Department of Scientific and Industrial Research: Report of Forest Products Research Board, with the Report of the Director of Forest Products Research, for the Year 1934. Pp. vi+75+2 plates. (London: H.M. Stationery Office, 1935.) 1*s.* 6*d.* net.

Educational Topics and Events

CAMBRIDGE.—The Rockefeller Foundation has agreed to make a grant of not more than £1,200 a year for five years from January 1 for research in cellular physiology at the Molteno Institute under the direction of Prof. D. Keilin.

Dr. P. Maitland, of Jesus College, and Dr. B. C. Saunders, of Magdalene College, have been appointed University demonstrators in the Department of Chemistry.

At Girton College, Dr. M. L. Tomlinson has been elected to a research fellowship.

LONDON.—Dr. Thomas Nicol has been appointed to the University chair of anatomy tenable at King's College. He has been since 1927 senior lecturer in, and for a time acting-head of, the Anatomy Department in the University of Glasgow.

The title of emeritus professor of town planning in the University has been conferred on Prof. S. D. Adshead on his retirement from the University chair of town planning at University College.

An offer by Sir Montague Burton for the partial endowment of the University chair of international relations tenable at the London School of Economics has been accepted with thanks ; the title of the chair is to be changed to 'Montague Burton Chair of International Relations'.

OXFORD.—William Hume-Rothery, of Magdalen College, has been granted the degree of D.Sc.

THE annual report for 1934 of the University of Leeds gives prominence to university housing problems and their solution. It assures subscribers to its building fund—nearly half a million sterling—inaugurated in 1925, that they have "once for all laid securely the foundations of the future usefulness and prosperity of the University". The new buildings have already, it is stated, lengthened the years of usefulness of men whose health was precarious in the former makeshift and exiguous quarters. The realisation of a long-deferred project for acquiring an adequate Students' Union Building is now in sight, thanks to a gift of £25,000 by Mr. W. Riley-Smith, of Tadcaster. The new library for which Lord Brotherton left £100,000 will be ready next March, and will house the famous Brotherton collection, the transfer of which to the University was effected on October 31 with impressive ceremony in the presence of the Chancellor. One of the most significant events of the year was the approval of a proposal for a School Certificate to be followed by a Higher School Certificate on a broader basis as a condition of entrance to the University, and the discontinuance of the issue of Matriculation Certificates. This should check the crying evil of the distortion of school curricula to make them fit in with Matriculation Certificate requirements. New links with secondary education were formed by establishing a Secondary Schools Council, consisting of an equal number of headmasters and headmistresses on one hand and members of the Senate on the other, for discussing matters of common interest. Among other important items of research work during the year was an investigation of the method of X-ray analysis as applied to biological tissue. For this the Rockefeller Trustees agreed to increase their grant to more than £1,000 a year for three years.

Science News a Century Ago

Memorial to Watt at Manchester

ON Monday, January 11, 1836, "a most numerous and highly respectable meeting took place in our Town-hall," said a Manchester correspondent of *The Times*, "for the purpose of taking into consideration the best means of perpetuating the memory of the late celebrated James Watt Esq., whose splendid discovery of the condensing steam-engine has conferred such incalculable benefits upon the civilized world, but especially in this important district. . . . Lord Francis Egerton, M.P. for the southern division of this county, and as heir to the Bridgewater property in Lancashire . . . has intimated his intention to our authorities to erect a monument to the memory of the late Francis, Duke of Bridgewater . . . Ought the two monuments be erected close to each other—the Duke of Bridgewater as the father of our inland navigation, and Watt as the inventor of the condensing engine ?"

Nothing came of the proposal at the time, but about twenty years later the matter was taken up again and on June 26, 1857, the bronze statue of Watt by Theed now in Piccadilly, Manchester, was unveiled.

The Zoological Society

AN ordinary scientific meeting of the Zoological Society was held on January 12, 1836, William Yarrell being in the chair. "The chairman presented a case containing a male and female dottrell, with a young bird and an egg, just received from Mr. Hesham at Carlisle, which had been taken on Skiddaw, and consequently proved incontestably, for the first time, that this bird is bred in Britain. Mr. Gould presented several specimens of Indian crows from Asia, two rare varieties of which were from the Himalaya Mountains, as well as several species of mocking birds from North and South America and the West Indies. . . . Among the company were the Dean of Carlisle, Dr. Beck from Copenhagen, Messrs. Bennett and Owen, Mr. Cumming, who is about to proceed on a voyage of natural history to Manila, and other distinguished naturalists."

The Government and Babbage's Calculating Machines

SO early as April 1, 1823, the Government had asked the opinion of the Royal Society on the merits and utility of Babbage's calculating machine, and with this began a correspondence lasting about twenty years. In his "Passages from the Life of a Philosopher", Babbage included a "Statement relative to the Difference Engine, drawn up by the late Sir H. Nicholas from the Author's Papers", and in this it is said "On the 14th of January, 1836, Mr. Babbage received a communication from the Chancellor of the Exchequer (Mr. Spring Rice), expressing his desire to come to some definite result on the subject of the Calculating Engine, in which he remarked, that the conclusion to be drawn from Mr. Babbage's statement to the Duke of Wellington was, that he (Mr. Babbage) having invented a new machine, of far greater powers than the former one, wished to be informed if the Government would undertake to defray the expense of this *new* Engine."

To this Babbage replied on January 20 that he did not perceive that his statement to the Duke of

Wellington contained *any application to take up the new or Analytical Engine*, which, however, he said "is not only capable of accomplishing all those other complicated calculations which I had intended, but it also performs all calculations which were peculiar to the Difference Engine, both in less time, and to a greater extent: in fact, it completely supersedes the Difference Engine." Six years later, on November 4, 1842, the then Chancellor of the Exchequer wrote saying that he and Sir Robert Peel "both regretted the necessity of abandoning the completion of a machine, on which so much scientific labour had been bestowed."

Electrostatics: The Great Cube at the Royal Institution

IN December 1835 Faraday had begun his researches in electrostatics with some experiments on a large copper vessel, borrowed for the purpose. Not satisfied with this, it occurred to him to use a large paper box or cube big enough for him to get inside; and this, early in January, he set to work to make. "Have been for some days past engaged in building up a cube of 12 feet in the side" he wrote on January 15. "It consists of a slight wooden frame, constituting the twelve linear edges, held steady by diagonal ties of cord; the whole being mounted on four glass feet, 5½ inches long, to insulate it. The sides, top and bottom are covered in with paper". The frame was also strengthened with ties of copper wire, which, with some slips of tin foil pasted on the inside, served to conduct electricity to all parts of the paper covering. "The whole stands in the Lecture room. . . . The cube rises in the middle of the room above the level of the bottom of the gallery, and appears of enormous size".

The cube was electrically charged from a frictional machine until sparks flew off at the corners; and with it, Faraday confirmed and extended the observations he had made with the copper vessel. The whole of the electricity resided on the outside surface. An insulating stool was brought up immediately under the bottom of the cube, so as to provide a firm platform and yet preserve the insulation. "I now went inside the cube, standing on the stool, and Anderson worked the machine until the cube was fully charged, and he continued working the machine. I could by no appearance find any traces of electricity in myself or the surrounding objects. I could not affect the gold leaf electrometer within". Delicate electrometers, candle flames and other means of detection were tried, but from no point inside could any evidence of electrical charge be obtained. "The electrification without produced no consequent effects within".

Procedure in Scientific Societies

ON January 16, 1836, *The Times* published a letter from "Observator" which said: "It will not, I hope, be considered as improper to respectfully to call the attention of presidents and secretaries to an evil of considerable magnitude, which has crept into the public proceedings of some of our scientific bodies of late years—I mean the very low tone in which announcements are often made from the chair, and papers read by the secretaries. . . . One would be tempted to believe, indeed, that an idea of dignity is sometimes connected with inaudibility. . . . Let, however, a president or secretary only consider himself as addressing the distant part of the persons present and the evil will be remedied. . . ."

Societies and Academies

EDINBURGH

Royal Society, December 2. J. WEIR and D. LEITCH: Zonal distribution of the non-marine lamellibranchs in the coal measures of Scotland. All zones from *ovalis* to *tenuis* are represented in the Scottish Coal Measures, although they cannot all be delimited. The Productive Coal Measures fall within the *ovalis*, *modiolaris* and lower *similis-pulchra* zones, and are therefore homotaxially equivalent to the lower part of the Middle Coal Measures of Lancashire. In the Central Coalfield the boundary between *ovalis* and *modiolaris* zones is taken at the Kiltongue Musselband, and between *modiolaris* and *similis-pulchra* zones at the Musselband Coal. Correlations between Central, Douglas and Ayrshire coalfields are deduced. S. CHAPMAN: The lunar atmospheric tide at Glasgow. Reasons are given for believing that the lunar hourly inequalities of barometric pressure at Glasgow recently determined by Robb and Tannahill are substantially not of lunar origin at all (see NATURE, Nov. 16, p. 801). An earlier determination of the lunar atmospheric tide at Glasgow made in 1926 by Robb is now published with his permission, and appears to be a true lunar effect. It indicates that at Glasgow the lunar atmospheric tide is abnormally small for the latitude; the phase seems normal, and corresponds to a lag of high tide in the atmosphere of about one hour after lunar transit. ENID CHARLES: The effect of present trends in fertility and mortality upon the future population of Scotland and upon its age composition. Excluding the effects of migration, estimates of the population of Scotland during the next hundred years have been made on two assumptions, (*a*) that fertility and mortality remain at their present level, and (*b*) that they continue to decline at the rate shown in the past decade. According to (*a*), the population will begin to decline slowly about 1970, being 94 per cent of its present size in a hundred years. According to (*b*) the population will begin to decline about 1950 and thereafter will diminish rapidly, being 19 per cent of its present size in a hundred years. The effects of past declining fertility and of present low fertility will be seen in a continually decreasing proportion of children and increasing proportion of persons aged sixty years and more. The excess of females due to war losses will be replaced by an excess of males in 1960 by both estimates. In fifty years the increasing proportion of the older age groups will result in a higher crude death rate, between 18 and 21 per thousand. A. C. AITKEN and H. T. GONIN: Fourfold sampling with and without replacement. The correlation is examined of characters in a sample drawn at random from a limited population, the individuals of which are classed in four categories, as possessing two characters or their alternatives. In the cases both of replacement and of non-replacement of sampled individuals, the probability is found to be expressible as a terminating series in orthogonal polynomials. These are briefly studied, and applications are made to problems of regression and moments.

PARIS

Academy of Sciences, December 9 (*C.R.*, 201, 1157–1232). The president announced the deaths of Charles Richet and Henri Jumelle. MARIN MOLLIARD: The effect of an enrichment of the atmosphere in

oxygen on the development of plants. Description of experiments on the radish and on a mould, *Sterigmatocystis nigra*. Increase in the proportion of oxygen slows down the development, and in the case of the radish, leads to a loss in dry weight. ALEXANDRE GUILLIERMOND : The sexuality of the yeasts and on the relations of these fungi with the Exoasceæ. GEORGES PÓLYA : A general combinatory problem on groups of permutations, and the calculation of the number of isomers of organic compounds. LUCIEN GODEAUX : Involutions of the second order belonging to certain algebraical varieties of three dimensions. DANIEL BARBIER and VICTOR MAITRE : A new method for the study of the absorption of light in interstellar space. RENÉ LUCAS : The propagation of ultra-sounds in liquid media. CLAUDE CHARMETANT : The electrolysis of the bromides and iodides of zinc, nickel and cobalt in mixtures of water and ethyl alcohol. MLLE. MARGUERITE QUINTIN : The mechanism of hydrolysis in solutions of the salts of the heavy metals. The study of the hydrolysis of the salts of bivalent metals leads to a simple relation, choosing the activity of the metallic cation and that of the hydrogen ion as variables. This would appear to point to the fact that the first stage of the hydrolysis is the formation of a complex ion. HENRI TRICHÉ : Contribution to the study of the structure of alloys by means of spectrography. By a suitable preparation of the alloy, it is possible to make a qualitative (for some constituents quantitative) analysis for impurities without the necessity of isolating them. CHOONG SHIN-PIAW : The emission spectrum of tellurium oxide, TeO. JEAN PAUL MATHIEU : The absorption, optical activity and configuration of mineral complex compounds. LOUIS LEPRINCE-RINGUET : The sign and the nature of the ultra-penetrating particles of the cosmic radiation. Study of the particles in a Wilson chamber placed in a powerful magnetic field and after filtration through 7 cm. of lead. The energy of such particles is not less than 700 million electron-volts. Positively and negatively charged particles are present, those with positive charge predominating. NÉDA MARINESCO : The deflagration of explosive substances by ultra-sounds. Description of experiments showing how ultra-sounds can be used to explode nitrogen iodide, silver fulminate and a number of powders of the Berthollet type. PAUL CORRIEZ : X-ray diagrams of sugar charcoal subjected to different thermal treatments. Various specimens of sugar charcoal, after heating to temperatures between 1,000° C. and 2,000° C., never give an X-ray diagram identical with that of natural graphite, but, as the temperature is increased, the lattice distance diminishes and approaches that of graphite. ANDRÉ MICHEL and GEORGES CHAUDRON : The study of stabilised cubic ferric oxide. JEAN BUREAU : The system water – lithium nitrite : the hydrate $LiNO_2,1{\cdot}5H_2O$. ERNEST KAHANE and T. TOMESCO : The action of perchloric acid on iodine and on iodine derivatives. The determination of iodine in organic substances. Study of the conditions under which the equation $7HClO_4 + 4KI = 4HIO_3 + 3HCl + 4KClO_4$ is strictly fulfilled. JEAN AMIEL : The preparation and properties of double chlorides and bromides of bivalent nickel and organic bases. ANTOINE WILLEMART : Researches on the dissociable anthracene oxides : the influence of naphthyl groups. PAUL GAUBERT : The microchemical determination of cholesterol, urea, glycerol, etc., based on the formation of liquid crystals. GILBERT MATHIEU : The different coal formations of the Bassin de Vouvant (Vendée et Deux-Sèvres). GEORGES DENIZOT : The constitution of the *vals* of the Loire and on the meaning of the hillocks not covered by floods. M. and MME. FERNAND MOREAU : The cytological phenomena of the development of the egg and of fertilisation in fungi of the Saprolegnite group. MARC SIMONET : Contributions to the cytological and genetic study of some *Agropyrum*. ROBERT BONNET and RAYMOND JACQUOT : The glucidic metabolism of *Sterigmatocystis nigra* is a function of the nitrogen source of the culture medium. EMILE MICHEL-DURAND : The metabolism of phosphorus in the leaves of some plants with persistent foliage during change to yellow. P. NOTTIN and A. DARON : The examination of wheats and flours by means of the Chopin extensimeter. The importance of working with a paste with a definite proportion of water is emphasised. PHILIPPE JOYET-LAVERGNE : The detection of vitamin A in the red blood corpuscles of the blood of vertebrates. ANTOINE MAGNAN and HENRY GIRERD : The determination of the pressures on the wings of a pigeon during taking off, horizontal flight and landing. LOUIS BOUNOURE : An experimental proof of the role of the germinal determinant in the russet frog. GEORGES BLANC, M. NOURY and M. BALTAZARD : Precedence and pre-immunity in the course of exanthematic typhus and in the course of hidden infection by bile-treated virus. RAYMOND MOUSSU : The physiological prevention of epizootic abortion in cattle. WLADISLAS KOPACZEWSKI : The seric proteins in cancer.

LENINGRAD

Academie des Sciences (*C.R.*, 3, No. 6, 1935). G. A. KRUTKOW : Further notes on the Brownian movement of a particle with axial symmetry. L. N. SRETENSKIJ : A problem of minimum in the theory of ships. P. A. WALTHER : Hodograph of an ideal hydraulic girder. N. V. KREMENEVSKIJ : Absorption spectrum of lead vapour in the Schumann region. P. D. DANKOV : Heterogeneous catalysis theory. W. A. FABRIKANT and A. S. KANEL : Influence of pressure on the radiation emitted by cadmium vapour. W. W. SHULEJKIN : On the 'voice' of the sea. The air passing over a disturbed surface of sea develops oscillations which may spread over great distances and be observed by means of a balloon filled with hydrogen which, by resonance, produces a sound effect. These facts may serve as a basis for storm warnings. B. M. DUBININ : Action of isobutylene on methyl phenol ether and the structure of pseudo-butyl-methyl phenol ethers. N. A. and V. A. PREOBRAZHENSKIJ and A. M. POLJAKOVA : Alkaloids obtained from the leaves of jaborandi. The synthesis of the alkaloid pilocarpidine. S. BALACHOVSKIJ : The reed (*Phragmites communis*) as a source of vitamin C. V. S. SADIKOV and E. V. LINDQUIST-RYSAKOVA : Acid autoclaving of blood albumin at 220°. L. M. DOROCHOV : An instrument for the determination of humidity in an air current during physiological investigations. A. J. IVANOV : Forms of the genus *Budytes*. L. A. PORTENKO : A new form of the willow-wren from north-eastern Siberia : *Phylloscopus trochilus expressus*, subsp.n. Known geographical forms are revised. R. J. BELKIN and A. A. WOITKEWITSCH : Influence of quinine on the realisation of morphogenetic action of the pituitary hormone.

Forthcoming Events

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

Monday, January 13

UNIVERSITY OF LEEDS, at 5.15.—Dr. Sidney Goldstein: "Fluid Motion and Aeroplane Wing Theory".*

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—A. S. Vernay: "Two Great Cities of Tibet" (Geographical Film).

Tuesday, January 14

UNIVERSITY COLLEGE, LONDON (CHEMICAL AND PHYSICAL SOCIETY), at 5.—C. F. Goodeve: Presidential Address.

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION), at 6.30.—Discussion on "Ultra-Short Waves for Broadcasting" to be opened by Sir Noel Ashbridge.

ILLUMINATING ENGINEERING SOCIETY, at 7.—(at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1).—F. E. Lamplough: "Applications of Ultra-violet Light and Some Aspects of Fluorescence and Phosphorescence".

Wednesday, January 15

ROYAL MICROSCOPICAL SOCIETY, at 5.—(at B.M.A. House, Tavistock Square, London, W.C.1).—Annual General Meeting.

Prof. W. A. F. Balfour-Browne: "The Evolution of Social Life among the Insects" (Presidential Address).

ROYAL SOCIETY OF ARTS, at 8.—Dr. L. H. Lampitt: "Food and the World".

ROYAL ENTOMOLOGICAL SOCIETY OF LONDON, at 8.—Annual General Meeting.

Dr. S. A. Neave: "The Relations between Mankind and the Insect World" (Presidential Address).

Thursday, January 16

LONDON MATHEMATICAL SOCIETY, at 5.—(in the rooms of the Royal Astronomical Society, Burlington House, W.1).—Discussion on "Probability". Speakers: Prof. H. Levy, Sir Arthur Eddington, Dr. P. Dienes, Prof. R. A. Fisher, Dr. Harold Jeffreys, Prof. J. B. S. Haldane.

CHEMICAL SOCIETY, at 8.—(at the Royal Institution).—Discussion on "Stereochemistry" to be opened by Dr. W. H. Mills. Other speakers: Dr. P. Maitland, Prof. S. Sugden, Prof. Alex. McKenzie and Dr. E. E. Turner.

Saturday, January 18

BRITISH MYCOLOGICAL SOCIETY, at 11.—(at University College, Gower Street, W.C.1).—Symposium and Discussion on "Laboratory Technique for Evaluating Fungicidal Properties".

Official Publications Received

Great Britain and Ireland

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 29: The Mechanical Aspect of the Nutrition of Farm Stock. By E. J. Sheehy. Pp. 257–280. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s.* 6*d.* [912

List of Geological Literature added to the Geological Society's Library during the Year 1934. Compiled by the Library Staff. Pp. iv+328. (London: Geological Society.) 10*s.* [1212

The Hastings Natural History Society. Report and Balance Sheet for the Session 1934–35, Council, and List of Members. Pp. 12. (Hastings: Hon. Secretary, 23 Charles Road, St. Leonards-on-Sea.) [1212

The Royal Horticultural Society. Lily Year-Book, 1935. (No. 4.) Pp. iv+140+25 plates. (London: Royal Horticultural Society.) Paper, 5*s.*; cloth, 6*s.* [1212

University of Bristol. Annual Report of Council to Court, 1934–35. Pp. 52. (Bristol: The University.) [1312

Hull Museum Publications. No. 185: Excavations at the Roman Fort at Brough, E. Yorkshire, 1934. By Philip Corder. Pp. 37. 1*s.* 2*d.* No. 186: Wilberforce House, Hull. By T. Sheppard. Pp. 24. 2*d.* No. 187: Record of Additions. Edited by Thomas Sheppard. Pp. 34. (Hull: Hull Museum.) [1312

Other Countries

Meddelelser om Grønand udgivne af Kommissionen for Videnskabelige undersøgelser i Grønland. Bd. 93, Nr. 6: Some Records on Birds New or Rare to Greenland. By Finn Salomonsen. (Miscellaneous Notes on Greenland Ornithology, 2.) Pp. 16. 0.75 kr. Bd. 95, Nr. 3: Treaarsexpeditionen til Christian den X's Land, 1931–34. Zur Geologie und Petrographie der Nordostgrönländischen Basaltformation, 2: Die Sauren Ergussgesteine von Kap Franklin. Von Helge G. Backlund und D. Malmquist. Pp. 84+11 plates. 5.00 kr. Bd. 95, Nr. 4: Treaarsexpeditionen til Christian den X's Land, 1931–34. Marines Aptien von der Koldewey Insel (Nördliches Ostgrönland,) Von Hans Frebold. Pp. 112+8 plates. 6.00 kr. Bd. 95, Nr. 5: Treaarsexpeditionen til Christian den X's Land, 1931–34. Petrographie der Eklogiteinschlüsse in den Gneisen des Südwestlichen Liverpool-Landes in Ost-Grönland, nebst Anhang: Granulitartiger Gneis Nördöstlich von Kap Hope. Von Th. G. Sahlstein. Pp. 43+1 plate. 1.75 kr. Bd. 96, Nr. 3: Treaarsexpeditionen til Christian den X's Land, 1931–34. Upper Devonian Fossiliferous Localities in Parallel Valley on Gauss Peninsula, East Greenland, investigated in the Summer of 1934. By A. Erik V. Johansson. Pp. 37+3 plates. 2.00 kr. Bd. 99, Nr. 1: Treaarsexpeditionen til Christian den X's Land, 1931–34. Geologische Beobachtungen im Oberen Jura des Scoresbysundes (Ostgrönland). Von Hermann Aldinger. Pp. 128+3 plates. 6.50 kr. Bd. 99, Nr. 2: Treaarsexpeditionen til Christian den X's Land, 1931–34. The Upper Jurassic Invertebrate Faunas of Cape Leslie, Milne Land, 1: Oxfordian and Lower Kimmeridgian. By L. F. Spath. Pp. 82+15 plates. 5.00 kr. Bd. 99, Nr. 4: Treaarsexpeditionen til Christian den X's Land, 1931–34. Ein Plesiosaurier-rest aus Grönländischem oberem Jura. Von Friedrich Frhr. von Huene. Pp. 11. 0.50 kr. Bd. 100, Nr. 5: Treaarsexpeditionen til Christian den X's Land, 1931–34. Studies on the Egg-Capsules and Development of Arctic Marine Prosobranchs. By Gunnar Thorson. Pp. 71. 3.50 kr. Bd. 103, Nr. 2: Treaarsexpeditionen til Christian den X's Land, 1931–34. Some New Investigations of the Devonian Stratigraphy and Tectonics of East Greenland. By H. Bütler. Pp. 35. 1.75 kr. Bd. 103, Nr. 3: Treaarsexpeditionen til Christian den X's Land, 1931–34. Preliminary Report on the Caledonian Orogeny in Christian X's Land (North-East Greenland). By C. E. Wegmann. Pp. 59+3 plates. 3.00 kr. Bd. 104, Nr. 18: The Scoresby Sound Committee's 2nd East Greenland Expedition in 1932 to King Christian IX's Land. Birds (Aves). By Magnus Degerbøl and U. Møhl-Hansen. Pp. 30+1 plate. 1.50 kr. Bd. 105, Nr. 3: The Scoresby-Sound Committee's 2nd East Greenland Expedition in 1932 to King Christian IX's Land. Geological Investigations in East Greenland, Part 2: Geology of Kap Dalton. By L. R. Wager. Pp. 32+7 plates. 2.25 kr. Bd. 112, Nr. 1: De Østgrønlandske Expeditionen til King Christian den X's Land udfort i aarene 1926–27 og 1929–30. The Fossil Flora of Scoresby Sound, East Greenland, Part 4: Ginkgoales, Coniferales, Lycopodiales and Isolated Fructifications. By T. M. Harris. Pp. 176+29 plates. 11.00 kr. Bd. 117, Nr. 1: Grønlandsk Medicinsk Statistik og Nosografi, undersøgelser og Erfaringer fra 30 aars Grønlandsk Laegevirksomhed, 1: Grønlands Befolknings-Statistik, 1901–30. Med et Engelsk résumé. Pp. 83. 4.00 kr. (København: C. A. Reitzels Forlag.) [212

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