NATURE

SATURDAY, JANUARY 26, 1935

No. 3404 Vol. 135

CONTENTS

Evolution and Human Origins

EVERY year brings to light evidence which implies a far greater ambiguity for man than that given to him in the book of Genesis. The caves of Mount Carmel, for example, have quite recently been found to contain deposits, fully sixty feet in thickness and laden with fossil bones of man and beast, to say nothing of a succession of stone implements. The ancient Palestinians represent a breed of the extinct Neanderthal species ; the stone tools are of the kind used in Europe long before the onset of the last glaciation. Even more revolutionary are the contributions which Africa is now making to the solution of the problem of man's origin. East Africa is proving to be particularly rich in deposits laid down during Post-Pliocene times. In the oldest of these deposits, Dr. L. S. B. Leakey has discovered crudely worked hand-axes ; on the overlying beds he has traced a gradual refinement of this type of tool. He has also found fragments of the East African tool-makers. Yet the oldest of these deposits were laid down at least half a million of years ago. So it has been with every part of the Old World : China, Java, Australia, Italy, Spain, France, Germany, Belgium and England, each has contributed its quota of evidence.

Why is it that all the anthropologists who have had to interpret the evidence of these discoveries, have presumed that the theory of evolution is true, and that the Mosaic tradition is wrong ? The first reason is that the Biblical background of time is too restricted ; the evidence now at the disposal of anthropologists requires a time-scale which runs into hundreds of thousands of years. The second reason for the rejection of special creation as a manner of origin, is man's mode of development. He arises, as do all other vertebrates, from a fertilised egg : his development within the womb is almost identical to that pursued by the great anthropoids. Piltdown man, Heidelberg man, *Pithecanthropus* (Java man), *Sinanthropus* (Peking man), and Rhodesian man, have never been regarded by anthropologists as special creations : they have presumed that such fossil specimens were twigs which had fallen from the evolving tree of humanity. They have made many attempts —most of them purely tentative—to reconstruct man's evolutionary tree.

Anthropologists are prepared for criticism directed against the form they have given to their trees of human evolution, but they did not

anticipate that anyone would attempt to sweep out of existence their evidence and the superstructure they have built on it. This, however, is what *has* happened. Sir Ambrose Fleming, in his presidential address* on January 14 to the Victoria Institute, asserted "that this sedulously propagated hypothesis of man's age-long evolution by Darwinian Natural Selection . . . is the product rather of the imagination than based on indisputable evidence. . . . The cardinal error is that it substitutes as the ultimate source of all things an impersonal self-acting or automatic process of improvement, in place of the Will and Power of a personal, Self-conscious Creator and Father of Mankind. *Adherence to the doctrine of evolution is entirely inconsistent with belief in the fundamental doctrines of Christianity. . . .*" We have italicised the last sentence of this quotation because it seems to us that Sir Ambrose has loaded his dice very heavily against those who believe in evolution.

How, then, does Sir Ambrose deal with the evidence on which the anthropologists have built so much? First he sweeps away their time-table; he describes it as an "unjustified assumption" and as a "guess". Yet it is the kind of "guess" we all make daily when we seek to assess the age of the man, woman or child we may pass on the street. We have no difficulty in distinguishing between the ages of a boy of ten and a man of fifty. Geologists and anthropologists will certainly be astonished by Sir Ambrose's assertion that the history of *Homo sapiens* can be fitted into the calendar of Biblical dates. He prefers the chronology of William Hales, who assigned the creation of Adam to the year 5411 B.C. to that of Archbishop Usher, who gives 4004 B.C. as the eventful date. He regards "the palæontological or fossil evidence" as being "painfully small". He makes short work of the "discoveries" on which students of man's origin rely so much. "The few scattered remains represented by the Java, Heidelberg, Piltdown and Pekin 'man', as far as they are not truly animal may rather be regarded as biological abnormalities or cases of decadence rather than stages in an upward development."

Having dismissed these fossil remains from his consideration, Sir Ambrose is left with only two early forms of humanity to be fitted into the inspired scheme of special Creation—namely, Neanderthal man and Cro-magnon man. The latter he hails as real sons of Adam; he recognises in them the moral and spiritual attributes of true man. Seeing that the Cro-magnons appeared in Europe long before the ice-age had ended, and that Sir Ambrose admits that "there is evidence not altogether negligible that a last glacial epoch may have ended not much more than seven to ten thousand years ago", it is difficult to see how they could have made their way into Europe from the Garden of Eden if the event of man's creation did occur at the date postulated by him, namely, 5411 B.C. He apparently forgets, also, that the evidence from Egypt indicates that men were not only living in the valley of the Nile at that time, but were already sowing and reaping, spinning and weaving and burying their dead in the expectation of a life hereafter, for how otherwise can we explain the 'goods' which are found in the graves of the early Egyptians.

Very different is the position which Sir Ambrose assigns to Neanderthal men, who were in existence before the onset of the last glacial epoch. He refuses to regard them as true men; he maintains that they were destitute of "the mental and spiritual power" of true men. In this he is not just, for one of the most representative specimens of this species of extinct humanity, namely, the man of La Chapelle, was buried with weapons and food—which we may justly interpret as evidence of a belief on the part of his people that the dead had a life when the earthly one was over.

In connexion with the origin and nature of Neanderthal man, Sir Ambrose puts forward a "view" which raises a very interesting question. Is it permissible to alter in even the slightest detail the inspired word of the Bible? To do so is to bring the "inspired word" down to the level of a scientific hypothesis, for it is of the nature of a hypothesis that it may be altered to meet fresh facts as they arise. "There is another view," he said, "which may be put forward very tentatively and that is that between the anthropoid apes and true man with his psychical and spiritual as well as bodily structure, there *may* have been some species of hominoids created with more than ape intelligence, but not 'man' in the sense of the word used in the Bible. . . ." This view is put forward as an alternative to the "view" that Neanderthal man is a degenerate form of true man. Sir Ambrose's critics may fairly complain that he has gone beyond any justification obtainable from the Mosaic record. They may also complain that he cites only one version of the creation of man from

* Modern Anthropology *versus* Biblical Statements on Human Origin. By Sir Ambrose Fleming. Pp. 25. (London: Victoria Institute, 1935.) 1*s*.

the book of Genesis—namely, Genesis, i. 26. "Let us make man in our image, after our likeness." The fact that the book of Genesis is a composite work, and that it includes two versions of creation derived from separate sources has, of course, long been recognised by Biblical scholars. More instructive than the above version is the different description of the creative act given in Genesis, ii. 7, "and the Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul". We should have expected, too, mention of the manner in which Eve came into being, and how the prediluvial population of the world had arisen from a single pair.

We are sure that Sir Ambrose Fleming would not wilfully misrepresent the case of his opponents; yet there is no doubt he has been unfair to the Bishop of Birmingham. "There are," said Sir Ambrose in his lecture, "no sufficient reasons for declaring the evolutionary origin of the human race a definitely certain fact. Certainly none for assuring a general congregation in Westminster Abbey, as did Bishop Barnes, on Sunday, Sept. 25, 1927, that 'To-day there is among competent men of science unanimous agreement that man has been evolved from an ape-like stock'." In so far as anthropologists were unanimous in 1927 as they are to-day in regarding man as a product of evolution and not of special creation, we hold that the statement made by the Bishop of Birmingham was amply justified. We rejoice, too, to note that the new dean of St. Paul's, Dr. Matthews[1], supports the evolutionary doctrine of man's origin and in opposition to Sir Ambrose Fleming sees no incompatibility between the doctrine of evolution and the precepts of Christianity.

[1] *Daily Telegraph*, Jan. 18, 1935. "Evolution and the Human Race."

Malaria in Ceylon

THERE is unfortunately no doubt about the serious nature of the epidemic of malaria in Ceylon. The telegrams in the Press report that in the affected provinces no less than 3,435 deaths from malaria and fever occurred during the month of December, compared with a monthly average of 531 for the first nine months of the year. It is admitted, however, that these figures are not final. It has been reported that there have been more than half-a-million cases of malaria, and if the death-rate was 5 per cent, that would give us something like 25,000 deaths.

The first need in an outbreak like this is medicine and food, and the Government of Ceylon has been in the happy position of being able to draw supplies of quinine from both India and Java. There is, however, another greatly complicating factor, and that is famine. The drought which has prevailed—and is generally regarded as the cause of the epidemic—has led to a serious failure of crops, and, even if the rain had not failed, the people themselves have been so weakened by disease that they have not been able to cultivate their fields. We may therefore expect that, in a people weakened by want of food and by malaria, this epidemic will be followed by a serious outbreak of dysentery and a rise in the general death-rate from all causes.

The epidemic itself has not been caused as epidemics frequently are—by the introduction of non-immune people into a malarial territory. The outbreak is in a part of Ceylon which is normally healthy. The new factor has in all probability been an increase in the number of mosquitoes. Among any healthy population in the tropics there is always a certain number of people carrying the infection; and when, as appears to be the case in Ceylon, there is a large increase in the number of mosquitoes, it is easy for the mosquito to acquire infection and to start a serious epidemic. Once a mosquito is infected it remains infected for life; and, further, as this epidemic is occurring among people who are not accustomed to malaria, the epidemic is so much the worse.

Valuable entomological work has been done in Ceylon by the Government Entomologist, but in view of this great epidemic there must be a full reinvestigation. Until we get that, everything is necessarily speculative.

One hypothesis is that, owing to the drought, rivers are not flowing so rapidly as they usually do, pools remain in the rocky and sandy beds, and *A. culicifacies* is breeding profusely. That may be so, but we must not forget that there are some thirty species of *Anopheles* in Ceylon and that they include species of the *A. minimus* group and *A. maculatus*, which in other countries are important carriers of malaria. A grave mistake might be made if a full investigation is not made into what mosquito, or mosquitoes, have been the active agents in producing this epidemic in the various parts of Ceylon to which the epidemic has spread.

Obviously the people of Ceylon were not

prepared for a great epidemic; it will be necessary for them to take stock of their position. The ancient cities buried in the jungle are a reminder that malaria is no new disease in Ceylon. Governing authorities should ask themselves: Have they used the knowledge that Ross gave them to the fullest possible extent, or have they made no special effort, thinking that nothing could be done?

Clearly some sort of inquiry will inevitably be held, but what is required is not so much a search for a scape-goat or an inquest, as a constructive scheme for the future, built on a sure scientific foundation.

Reviews

Newton's *Principia*

Sir Isaac Newton's Mathematical Principles of Natural Philosophy and his System of the World. Translated into English by Andrew Motte in 1729. The translations revised, and supplied with an Historical and Explanatory Appendix by Prof. Florian Cajori. Pp. xxxv+680. (Cambridge: At the University Press, 1934.) 35*s.* net.

ANDREW MOTTE'S translation of the "Principia" is not so well known as it deserves to be. It was supplied to his brother, the publisher, soon after Newton's death. One might expect it then to be no more than a publisher's hack work, of which we have so many dismal examples. But Motte appears to have understood the "Principia", and his language does not date noticeably, and never falls below a good level. The present work is really a republication of Motte, with some improvements, and—it is regrettable to add—one most serious omission.

Prof. Cajori died in 1930, so that the book has been seen through the press by Prof. R. T. Crawford, of the University of California, Berkeley. But the changes in Motte's text, the notes, and the work generally, is credited to Cajori. The notes seem to be complete, but might perhaps have been put into a compacter form, had the author lived. In their present shape, they give a certain number of references, but scarcely advance any of the subjects. Along with the "Principia" is a translation of the lectures given at Cambridge and called "The System of the World", which Prof. Cajori, apparently with good reason, also puts down to Motte. It is quite worth presenting, for, though it is not so complete as the "Principia", it is less guarded and less austere.

One distinct improvement upon Motte is found in printing the diagrams among the text, as they were in the various editions of the "Principia". Motte, no doubt in the interest of economy, collected them together and put them into folders. Most of Prof. Cajori's changes are modernisations. One requires to think a little, now, before one remembers the meaning of "sesquiplicate ratio" and the like. But nothing can be done to improve the awkward, old analysis, nor is Prof. Cajori quite consistent. Thus [*quantitas*] *genita*, retained by Cajori as "a *genitum*", is simply what we now call a function, and "square or cube sides" for "*latera quadrata, latera cubica*" is retained where the modern equivalent would be square root or cube root. Nor does he always correct Motte's mistranslations. In Newton's celebrated experiment upon apparent and absolute rotation, *situla* means a bucket, whereas Motte translates it a vessel, and Cajori retains this. It is a pity that the work did not fall into the hands of a stricter scholar.

But these are minor matters. The risk of a translation is that it may be more obscure than the original. The "Principia" was considered a hard book by people of the time, and Newton deliberately refused to make it more popular. In many places he wrote with the extremest compression. An example is the Second Definition, which runs "*Quantitas motus est mensura ejusdem orta ex velocitate et quantitate materiae conjunctim*". This figures here—scarcely changed from Motte—as "*The quantity of motion is the measure of the same, arising from the velocity and quantity of matter conjointly*". This seems to me more obscure than the Latin original. The comma and the 'the's have spoiled it. As one pores over the original words, one reflects that Newton was a geometer, who said, when he pleased, everything at once, so that all parts of his statement must be taken together. Newton picked his words, and in many places one will prefer to see what Newton himself wrote, not what Motte or Cajori made of it.

Yet the book is a pleasant book, and to the large but not universal class who read English more easily than Latin, it presents distinct advantages in finding one's way about. It is doubtful whether it will be read by so-called 'students', which may be taken to mean young men in a hurry. The great defect of the book is that it has not an index. A fairly good index was added to the second edition, and Motte gave one too, but Cajori has suppressed it. There are multitudes of details dealt with here, some of them most unexpected, such as remarks upon the finite velocity of light, and significant both for what Newton said, and what he did not say. In fact, the "Principia" must be easily the most

interesting scientific book ever written. It is nearer to our own time than Euclid's "Elements". Besides, those that have read Sir Thomas Heath's translation and notes on the original text know that the versions that have reached us are very much doctored.

The original "Elements" were not at all a school book, but were of philosophical intention; and most of the questions treated by Euclid are now uninteresting. The "Principia", on the other hand, besides being the bible of the modern scientific method which has now overrun the whole world, discusses a host of questions that are still alive. A short reminder of its contents proves this. It begins with a brief philosophical discussion. Newton is always briefest when he has thought most and has made up his mind. Then the laws of motion. The principles of dynamics, including some significant forecasts. Absolute and relative rest. The interpretation of Kepler's laws. The geometry of conics. The calculus. The law of gravitation. Detailed inferences as to the disturbances of the sun and moon upon the earth—one of the propositions has as many as twenty-two corollaries, many of them of lasting importance. Resistance of bodies. The form of the "body of least resistance". Many detailed and admirable descriptions of experiments. The velocity of sound. Some important reflections upon light. Applications of the law of gravitation to the heavens. The proof that it is gravity which retains the moon in its orbit. The precession of the equinoxes. The tides. The lunar theory, giving a very adequate calculation of the variation and of the motion of the nodes, and a less adequate calculation of the change of excentricity and the motion of the apses. The motions of comets, showing that they obey exactly the law of gravitation. Numerous personal references. Numerous general scholia, containing remarks at large upon all kinds of questions, such as the relations of the Deity to human affairs.

This is a brief and imperfect list, but it will serve its purpose. Surely never was such a torrent of thought produced by eighteen months' work. The main points may have been ready before, but many of the details must have been added as the book was written. No one really knows what may be in the "Principia", and one is likely to forget one part while one puzzles over another, deciding whether Newton was right—for there are inevitably a good many errors—and picking out the gems of profound thinking from the old-fashioned analysis and mode of expression. Not to give an index to a book like this largely defeats the purpose of the volume. The original index ought to have been enormously extended in place of suppressing it altogether. One would willingly have sacrificed the fifty pages of notes for the purpose.

Motte did not try his hand at Halley's verses. In the second edition, Bentley touched them up, improving their latinity, I suppose, but I prefer them as Halley left them. They are worthy of the book, and of the part Halley played in producing it. The eloquent passages seem to me to have been meant. Here we have a translation by "Leon J. Richardson, Professor of Latin in the University of California". It is a poor affair and gives no evidence that the writer knew what he was talking about. "*Cur remeant nodi curque auges progrediuntur*" was left untouched by Bentley, but does not figure here—the evil-minded may suspect that Prof. Richardson did not know that the apses moved forwards and the nodes backwards, nor thought it remarkable when it was mentioned. No ancient that wrote on astronomy would have missed the point. There is also a photograph of the portrait in Magdalene College, Cambridge, which Edleston published; and a reproduction of the title page of the first edition, somewhat reduced laterally to make it fit.

R. A. S.

Tea and Tea Production

The Culture and Marketing of Tea. By Dr. C. R. Harler. Pp. xii+389+8 plates. (London: Oxford University Press, 1933.) 12*s.* 6*d.* net.

DR. HARLER informs us that "the first authentic account of tea was written by Lo-yu who lived about A.D. 780. He describes the preparation of the leaf, which, he says, must only be picked during certain moons and not when it is raining or the sky cloudy": that "China, the classic tea country, gave both the word 'tea' and the beverage to the world"; and that "the words *te*, *chia* and *cha* denote tea in various Chinese dialects and in one or other of these forms has been transposed into most other languages". The first pound of tea imported into England is attributed to Lord Arlington in the year of the Great Plague of London (1665–66). It cost his lordship sixty shillings and was brought by him from Holland. His residence, Arlington House (demolished in 1703), at that time was on the site where Buckingham Palace now stands (*see* "Old and New London", by Edward Walford, vol. 4, p. 62).

"Tea was known in Europe in the middle of the sixteenth century and the Dutch began importing it early in the seventeenth century. In Queen Anne's reign, tea drinking in England became fashionable and rapidly spread. In 1703 the import into England was 100,000 lbs. About a century later in 1805 it was 7½ million lbs. Tea

was still then a 'China drink' and remained so for many years." Now, out of a world's production of about 900,000,000 lb. the British Isles takes approximately half the amount. Dr. Harler (p. 373) furnishes the interesting facts that "the annual tea consumption in Great Britain is about 9 lbs. per head" and that "in Russia in normal times, the annual consumption per head in the towns is 3·7 lbs., in the villages 0·37 lb., in Siberia 1·8 lb. and in Russian Central Asia and Turkestan 2·7 lbs.".

A correspondent some time ago in the *Tea and Coffee Trade Journal* gave the British Isles as the largest consumer in Europe—9·87 lb. per annum: at the same time quoting the figures for Germany, 0·20, Italy 0·009, France 0·09, and Holland 3·17 lb. per head respectively.

London is the most important market for tea, and it is practically the centre of the trade for all countries and, as with spices, so with tea the market is concentrated in Mincing Lane and immediate neighbourhood, where the stocks at any one time may lie between 100 or 200 million lb. and upwards.

At the present time it would seem that the tea trade, like certain other great agricultural industries, is suffering from over-production, and according to the work under review (p. 382) "drastic steps were taken at the end of 1932 to reduce stocks", and an agreement was made between India, Ceylon and the Netherlands East Indies, which was calculated to put about 120 million lb. of tea less on the market in 1933. The scheme is subject to modification from time to time for five years, and although the early effect on prices, it is considered, has been highly beneficial, the ultimate advantages would appear to be somewhat indefinite.

In the preface, the author states that his book does not pretend to be an exhaustive treatise on tea, but records his experience during the fourteen years he had been connected with the tea industry in north-east India as a scientific worker in the service of the Indian Tea Association. Nevertheless, the volume produced is serviceable and comprehensive. On page 73 he records the facts that "when tea cultivation was introduced first into Java in 1825 and India in 1835, Chinese methods of preparation were employed. The industry developed steadily in Assam and Northern Bengal and in these areas, collectively referred to with regard to tea as north-east India, hand methods were gradually replaced by machinery from 1870 onwards and distinct modifications in the Chinese process were introduced. In Java and Ceylon the industry developed at a later date, and these countries have taken the methods of north-east India and adapted them to local conditions." Four chapters are devoted to north-east India, dealing with general aspects of the country, geology, climate, soils, etc., the development, culture and manufacture of tea, in the third part of the work. The whole subject is dealt with in four parts, the first giving a general description of the tea plant and tea production, the second on chemistry and pharmacology of tea; the third part—in addition to the four chapters—as above referred to, also includes chapters on tea in China and Japan, Formosa, Ceylon, Java and North and South India, and the fourth part, in two chapters, deals with the "British Tea Trade", the marketing, production and consumption of tea.

There are eight good illustrations, and two maps—of north-east India, showing tea areas, and south-east Asia, including the tea districts of China and natural tea tracts.

The useful modern works on tea are not numerous, and the author is to be congratulated on making an excellent addition to our store of knowledge on the subject. J. H. H.

Science and Social Welfare

L'Économie humaine par la médecine sociale. Par René Sand. Pp. vii+305. (Paris: Les Éditions Rieder, 1934.) 30 francs.

IT would be difficult to over-praise this book, which ought to be promptly translated into the chief European languages. Nothing similar has yet been attempted, although, when done, one wonders why it has been left to Dr. René Sand. The reason no doubt is that he is a Frenchman, with the French gift for clear arrangement and for making the abstract attractive. Within three hundred pages one has a perfect conspectus of what science, especially medical science, has done to raise the general health, and promote social welfare, within the last few decades. Though the general conclusions are amazingly encouraging, there is no attempt to gloss over the black spots, which are described here and there with a poignant pen.

The most useful is the earlier part of the book, in which is given a comparison which could scarcely be found elsewhere, of vital statistics with other conditions of life, sex, race, economic position and so on. Two or three general conclusions stand out in startling uniformity. One is, the universal agreement of better health with better economic conditions. Another is the similarity of the movement in all countries, just in proportion to the degree in which they have organised their social services. The third, and most hopeful, is the steady increase in improvement in all the years under review—except, of course, in certain obvious cases due to the War. Even the two recent years,

which the author refers to as 'la crise', have not seriously abated the upward trend.

The knowledge shown of all the agencies at work, in what is usefully defined as 'la médecine sociale', is colossal. Every author, every society and every movement in the civilised world comes under review and yet there is no crowding and no tedium. The book is as easy and attractive to read as it is comprehensive and convincing. It is, of course, what would in a loose sense be called 'socialistic', and towards the end the author adopts the 'ought' tone rather more frequently than is quite consistent with a strictly scientific point of view. One feels here and there that something might be said in defence of more individual liberty and in qualification of the all-embracing paternal rôle which is assigned to the State and the community. But this is no place to discuss a very large philosophic question. Let us be thankful for the indisputable evidence of vital progress which the book affords, and hopeful for the continued benefits which science, wholeheartedly applied, holds forth in the future.

F. S. MARVIN.

Short Notices

Collected Papers of Charles Sanders Peirce. Edited by Charles Hartshorne and Paul Weiss. Vol. 3: *Exact Logic.* Pp. xiv+433. 24*s*. 6*d*. net. Vol. 4: *The Simplest Mathematics.* Pp. x+601. 25*s*. net. Vol. 5: *Pragmatism and Pragmaticism.* Pp. xii+455. 21*s*. net. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1933–1934.)

IT is difficult to deal adequately, even in a longer notice, with the extraordinary diversity of topics touched upon or discussed in these volumes. They fully support the editor's opinion that Peirce was "one of the most original and prolific logicians of the nineteenth century". Vol. 3 contains mainly papers on the algebra of logic and the logic of relatives, in which several improvements on Boole's method are suggested. There is also an excellent paper on the logic of number, and an essay on "The Regenerated Logic" which contains some pertinent remarks about the relations between mathematics, logic and philosophy. For example, Peirce draws a distinction between logic and mathematics, to which he denies the character of a positive science in so far as it does not deal with any aspect of reality; while philosophy does deal with reality, if not through special observations, yet by the study of the universal phenomena of experience.

Vol. 4 deals with the various aspects of the logic of quantity and with the use and interpretation of existential graphs as aids to logical theory. The remarkable chapter on the "Simplest Mathematics" begins with an interesting discussion about the essence of mathematics and its main divisions. There Peirce defines mathematics as "the study of what is true of hypothetical states of things" (p. 193).

Vol. 5 is perhaps the most important one for the history of thought, in view of the fact that it contains practically everything of importance which Peirce is known to have written concerning his famous theory of "how to make ideas clear". Half this volume is composed of hitherto unpublished papers. Some of his most striking conclusions are that logic is subsidiary to ethics and æsthetics; that pragmatism is a method of logic rather than a principle of metaphysics; and that pragmatism entails scholastic realism which, in its final pragmatic interpretation, means the ascription of purposive habits to Nature. These main theses are supported by a wealth of arguments covering the various aspects of the theory of knowledge. A conscientious study of this volume would no doubt help the reader to discover a certain interpretation of pragmatism which is not generally current among the followers of this doctrine.

Anatomy of Animal Types: for Students of Zoology. By Prof. E. A. Briggs. Pp. xix+250. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co., 1934.) 10*s*. 6*d*. net.

PRACTICAL courses dealing with animals are a strong feature in the teaching of elementary zoology such as is required for medical students. Many guides, dealing with suitable local animal types, have been published. Most of these are dry-as-dust 'anatomies', the use of which is preceded by lectures. These in the writer's student days dealt mainly with the forms of the different organs in a number of dead corpses, with notes on their evolution deduced from the same, whereas to-day the centre is the living animal in relation to its mode of life.

Here for Australia, especially Sydney, is a little textbook for the practical work. The animals chosen are Australian species, or cosmopolitan forms that have been introduced. Each is described as the student should examine it, proceeding from external features to internal anatomy, and suggestions are made as to drawings, dissections, microscopical examinations and so on. There are happily no illustrations in the book to distract the student's attention from the animal, the dissection of which is mainly of use in teaching observation and interpretation.

The author's views are sound; he wishes to approach his animal from two points, "firstly, that of structure, and, secondly, that of function", but we fear he has largely forgotten the latter—and such simple examinations of function as might be possible—in his maze of anatomical fact. His book is, nevertheless, an advance on most similar textbooks, but he should recast it on thoroughly modern lines so that Australian students may be freed from out-of-date manuals on practical zoology that are a curse not only to them but also render ineffective the best efforts of their teachers.

The Riddle of the Universe To-day. By Joseph McCabe. Pp. ix+250. (London: Watts and Co., 1934.) 5*s*. net.

THE author points out quite rightly that, in spite of some popular pronouncements about the idealistic or spiritual character of present-day science, the materialistic interpretation of knowledge continues to flourish as it did in Victorian days. A rapid survey of recent advances in every branch of science helps him to illustrate his contention, and to conclude that "neither physics nor mathematics could ever discover anything that would disturb the materialist. You might as well hope to discover a spiritual world by the use of the spectroscope" (p. 225). This is obvious if we restrict our knowledge artificially to the immediate data of the external world. But this is not the sense in which should be interpreted the assertion that materialism has lost the predominant position it held some years ago. This assertion simply means that the recent advances in the various sciences, coupled with the analysis of their possible interpretations, reveal in the world of inanimate things as well as in the mental and social life of the individual, a purpose, an order, a manifestation of causality which cannot be exclusively and ultimately accounted for in terms of matter. However important, necessary and immediate matter is for the ordering of our knowledge, we are bound to admit its allegiance to a higher principle, that is, to spirit, with all its implications. T. G.

Raumchemie der festen Stoffe. Von Wilhelm Biltz. Pp. x+338. (Leipzig: Leopold Voss, 1934.) 22.50 gold marks.

PROF. BILTZ is well known for his long series of researches on the physical chemistry of solids. In this book, which brings together much previously published material and also many determinations which have not otherwise been published, he attempts a systematic survey of the whole field, the primary object being the determination of the absolute volumes of the ions in crystals. The first part of the book consists of a number of detailed tables, in which the rich experimental material is collected in an easily appreciated form, and in the second part a detailed discussion of this quantitative material is presented.

Prof. Biltz has had the assistance of other specialists, and the resulting volume is one which possesses an unusual interest not only for chemists but also for physicists who are concerned with crystals. Full references to the literature are given, and the collection of numerical data in the tables would in itself make the book very useful. When this is accompanied by a systematic and detailed attempt towards the interpretation of the results, the value of the book is considerably enhanced. The relations with valency are particularly emphasised, and in this direction the monograph will appeal to both chemists and physicists. The book is one which can be recommended as both rich in information and also in theoretical discussions which reach into many fields.

Hydrology and Ground Water: a Practical Text-Book for the use of Civil Engineers, Surveyors, Students, and all those who deal with the Control of Water. By J. M. Lacey. Pp. viii+159. (London: The Technical Press, Ltd., 1934.) 10*s*. 6*d*.

THIS is the re-issue of a textbook which was first published about eight years ago, and is based on a series of articles which originally appeared in the columns of *Engineering*. It is a conveniently sized manual affording a good general survey of the subject in twelve chapters, which deal in turn with sources of water supply, measurement and variations of rainfall, evaporation, soil permeability, ground water and springs, run-off or surface yield, storage, floods and wells.

Within its limits, the book provides quite a serviceable guide to those who have to deal with questions of water supply and control, but, as it professes to cater for the needs of "engineers who are engaged in Water Works, Irrigation, and Drainage schemes", it must be said that there are several respects in which the information supplied on those subjects is somewhat meagre. Apart from floods, for example, land drainage receives no very conspicuous treatment. If one were disposed to be captious, exception might be taken to the opening statement that "the source of all water . . . is rain", ignoring the existence of snow, hail and dew as distinct forms of atmospheric moisture. It is true that snow and hail are mentioned on the succeeding page, but only casually and without explanatory comment. The formation of dew is left undescribed, and there is no mention of dewponds as a possible (though limited) source of supply. The section on wells is perhaps the best, as it is the most extensive, constituting 40 per cent of the volume, with examples of calculation of yield, which assume a knowledge of the calculus on the part of the reader. The author illustrates very largely from Indian practice.

B. C.

Indian Psychology: Perception. By Prof. Jadunath Sinha. Pp. xvi+384. (London: Kegan Paul and Co., Ltd., 1934.) 15*s*. net.

THIS very interesting work outlines and discusses the most important topics of Indian psychology with special reference to doctrines of perception. As there is scarcely any experimental psychology in India, introspection and observation are the basic methods displayed. This fact, coupled with the synthetic and metaphysical characteristics of the Indian mind, points to the dependence of psychological doctrines on the fundamental currents of Indian philosophy. Yet, observations and doctrines on specifically psychological questions are numerous and original enough to justify its special treatment. Prof. Sinha thus discusses the various aspects of Indian psychology in their proper setting. Subtle analyses of mental processes are revealed both in normal and in abnormal psychology. The three chapters on illusions, dreams and abnormal perception are very striking in this respect. Philosophers will welcome Prof. Sinha's book as an important addition to their library.

A Condensation Theory of Meteoric Matter and its Cosmological Significance

By PROF. BERTIL LINDBLAD, Director of Stockholm Observatory

IN connexion with a theory on the constitution and development of stellar systems, I have recently directed attention[1] to the significance of the great difference in temperature between the interstellar gas and solid interstellar particles as an explanation of the origin and growth of meteoric particles. If we assume with Sir Arthur Eddington[2] a temperature of 10,000° for the interstellar gas and, on account of the low energy density, a temperature of about 3° for solid particles, the latter must be assumed to grow by the condensation of sublimed matter on their surface. This conclusion is in accordance with the conclusions drawn by I. Langmuir[3] concerning the nature of the process of condensation of metallic vapours on solids. In the present case, the energy of impact of atoms on the surface of the particle will be rapidly radiated into space, or perhaps to some small extent transformed into sub-atomic energy, so that the particle remains cold. We assume that the interstellar gas actually contains all the elements in about the proportions formed in the earth's crust and in the sun, and that the apparent predominance of calcium and sodium is due to the easy accessibility of very strong spectral lines due to these elements, namely, the *H* and *K* lines and the *D* line. For atomic weight 50, the temperature 10,000° gives a mean speed of the atoms of 2 km. per sec., and assuming a density of 5 for the solid particles formed, we readily obtain the formula

$$m = 10^{36}(\rho t)^3,$$

for the mass m of the particle in grams after the time t since the formation of an 'infinitesimal' nucleus expressed in years. For the density ρ of the interstellar gas we may adopt Gerasimovic and Struve's[4] value, 10^{-26} gm. per cm.^{3}. In the time $t = 10^9$ years we then get particles of the size 10^{-15} gm., which is the order of magnitude of the particles in the obscuring clouds of the Milky Way according to the recent results derived by C. Schalén[5] from an investigation of the absorption effects in the photographic spectrum of early type stars in various Milky Way regions and an application of Mie's theory of the absorption of light by colloidal particles. It is remarkable that the mean density derived by Schalén from the number of particles per cubic centimetre agrees well with Gerasimovic and Struve's value for the interstellar gas. We may further remark here that the time of 10^9 years agrees with the average order of magnitude of the age of meteorites derived by an analysis of radioactive material.

The result obtained for the small interstellar particles encourages us to apply our formula to the formation of meteoric material in somewhat denser regions in space as well. Before leaving the small obscuring particles, we may add, however, that these particles will adopt motions corresponding to the mean motion of the interstellar gas, which we know follows closely the rotation of the stellar stratum around the centre of the stellar system situated in the direction of the constellation Sagittarius. (The distance to the centre is estimated to be 10,000 parsecs, or about 30,000 light-years. The period of rotation at the position of the sun in the system is nearly 2×10^8 years.) The consequence will be that the particles will get only small velocities relative to the circular motions, and will show a strong galactic concentration, presumably much stronger than the galactic concentration of the interstellar gas itself. This result is quite in accordance with the empirical data regarding the region of obscuration in our stellar system.

For an accumulation of material through gravitational forces to be possible in the case of an angular velocity of rotation corresponding to the period of revolution just mentioned, we should have a minimum density of about 10^{-22} gm. per cm.^{3}. In 10^9 years we get with such a density particles of 10^{-3} gm., which seems to be the minimum mass of observed meteors. We assume here throughout a temperature of about 10,000° for the gas and a temperature near zero (absolute) in the case of the particles. Even rather large changes in the temperature of the gas, however, will not affect the order of magnitude of m.

If we assume the sun and the planetary system to have evolved from a gaseous nebula, stretching at a certain time over the orbits of Neptune and Pluto with a reasonable concentration towards the central nucleus, we might estimate the density in the outer regions of such a nebula to be something like 10^{-15} gm. per cm.^{3}. We should then expect particles of 10^{18} gm., that is, one million million tons, to develop in 10^9 years. This is about the mass of one of the smallest asteroids. We do not suggest, however, that bodies of this size will go on condensing in this way undisturbed. We must expect particles of various size to combine occasionally to form still larger formations. On the other hand, especially in the denser regions near the central nucleus, the particles will run a great risk of being volatilised by violent encounters, and with increasing energy-density the temperature of particles will be too high to admit condensation.

Further, inside Roche's limit around the centre no formation of large particles is possible. Therefore there will probably be an optimum region for the formation of large bodies in the solar system, and we may assume this region to occur around the orbits of the giant planets Jupiter and Saturn. We may mention here the well-known fact that the planet Jupiter contributes about 60 per cent of the total angular momentum of the solar system.

The objection by H. Jeffreys[6] to the 'planetesimal theory' of Chamberlain and Moulton that the planetesimals are likely to volatilise entirely before contributing essentially to the formation of larger bodies of small orbital eccentricities and inclinations does not apply generally in our case, since the condensed particles are likely to possess from the beginning only small velocities relative to the circular orbits in the plane of rotation of the nebulous mass. In the extended solar nebula, viscosity will have produced at least roughly regular conditions, and because the pressure gradient is not likely to contribute much to support the gaseous matter against gravity, the mean motion of the gas, and hence the motion of the condensed particles, is likely to follow fairly closely the circular motion. I have further shown as a general theorem[7] that mild encounters leading to a dissipation of kinetic energy of the particles will, in the mean, lead to a concentration of the particles towards circular orbits in the plane of rotation. Still, owing to the large free surface per unit mass of the small particles, a very great number of these corpuscles will actually be evaporated by encounters; but some particles which succeed in growing without serious interruption will increase in size by accumulation of smaller particles at a rate probably exceeding considerably that of our condensation formula given above. It appears, therefore, that the net result of the condensation process will ultimately be a rapid growth of a comparatively small number of large bodies. We of course at once identify these bodies with the planets and their satellites.

We may ask, incidentally, if there are in the universe types of objects which in any way resemble the primordial solar system as depicted above. In actual fact, it is not unreasonable to assume that certain stars of early type with nebulous envelopes showing the reflected continuous spectra of the stars involved, which are not seldom observed in the Milky Way, constitute systems of a similar nature; that is, they consist of a stellar core inside a thin gaseous envelope which in the outer regions passes over into a meteoric cloud. When, however, the central nucleus reaches a very high temperature, there must be a strong radiation pressure on particles of a certain size[8]. In such a case we should expect not only an outgoing stream of small particles, for which radiation pressure increases with increasing size, but also an incoming stream of larger particles, for which the radiation pressure decreases with increasing diameter. It is possible, further, that larger particles have formed at some time before the nucleus acquired by contraction a very high surface temperature. Modern evidence[9] seems actually to indicate reflection by fairly large particles in the nebulous envelope. We may assume that the types of objects in our stellar system which show the strongest galactic concentration have actually formed in the 'present phase' of the stellar system, that is, during the time in which the stellar system has possessed its present mass, angular momentum and invariable plane. The minimum amount of time passed in this phase may perhaps be set down as 10^{10} years. This seems to be near the upper limit of the age of the earth's crust. If the sun, or rather the solar nebula, became differentiated out of the interstellar material in the present phase of the system, or during an earlier phase, seems therefore doubtful.

Returning to the formation of the planets from the gaseous and meteoric material of the solar nebula, in accordance with the lines of thought just outlined, we assume that the earth has been formed around a heavy core by accumulation of a great number of particles of various sizes. In addition to the considerations dealt with earlier, we may direct attention to the circumstance that, between neighbouring particles formed by condensation of atoms of very large mean free path, and by accumulation of free particles of larger size, there will be a certain additional pull due to their shielding one another with respect to the free atoms or corpuscles falling in towards their surfaces. As the accumulation may be thought to have been especially rapid at certain stages of the process, for example, in encounters with comparatively large bodies, the planet may ultimately have become heated to such an extent that at least the surface layers have been entirely in a fluid state, perhaps even incandescent. A temperature of 2,000° of the radiating surface may be upheld, if material of a mean space density about 10^{-9} gm. per cm.^{3} falls in towards the radiating surface with a mean velocity of 10 km. per sec. At a later stage, through loss of heat by radiation, simultaneous solidification all over the surface has taken place.

The formation of satellite systems is explained on general lines in a way analogous to the theory of formation of the planetary system itself. The fusion of particles of various sizes, leading to the formation of a massive planet, will in the first stage produce an incandescent nucleus with an extended gaseous atmosphere. The angular

momentum due to the satellite system and the rotation of the planet taken together correspond to the angular momentum of the matter which was sufficiently near a planetary nucleus to be retained in its neighbourhood by gravitation, or in the course of time has been caught in encounters. The direction of rotation should therefore be the *same* as that of the system as a whole, and thus that of the planetary orbits; the few exceptions to this rule are readily explained as accidental deviations due to local conditions (the Uranus system and the satellite of Neptune) or capture in recent times (Jupiter VIII and IX, Saturn IX). The strong correlation between the angular momentum of rotation of the planet and the mass of the satellite system is readily understood. Apparently singular objects like the satellites of Mars may be understood without making the assumption that these bodies have originated directly out of the mass of the planet.

The rings of Saturn are perhaps best explained directly as small particles formed by condensation inside Roche's limit for the planet in question. The extremely flat formation is explained partly by the condensation of the particles out of a gaseous cloud, which causes the particles to follow originally nearly circular motions with low inclinations, but mainly by the influence of mild collisions between neighbouring particles, as explained by Jeffreys[10] and on somewhat different lines by myself in a recent paper[11].

The corpuscles of the zodiacal light have possibly been formed fairly recently[12] out of the last remnants, perhaps reformed by volatilisation, of the nebulous cloud surrounding the sun.

Finally we must mention the probable status of the meteorites. Their division into, roughly, two widely different kinds, stony and iron meteorites, suggests that they can scarcely be considered exclusively as direct condensation products. We may perhaps get a general explanation of their physical nature, as well as of their motions, which obviously differ very much from the circular orbits in the invariable plane of the solar system, by assuming that they are, generally speaking, remnants of larger bodies, shattered by violent encounters in the manner which has been considered above. Like the planets, these larger bodies have therefore formed to a great extent by accumulation of smaller particles. We can then assume, in conformity with the views put forward by geophysicists[13], that a certain sedimentation of the various minerals has taken place at a fairly high temperature in the bodies in question before their disruption. Those meteorites which did not originally belong to our system have probably emanated from analogous systems in other regions of the Milky Way, forming showers of particles traversing the voids of interstellar space much like the stars themselves. In regard to their origin they are, according to our point of view, largely a sort of by-product in the process of formation of planetary systems.

[1] *Mon. Not. Roy. Ast. Soc.*, in press.
[2] "The Internal Constitution of the Stars", p. 371; 1926.
[3] *Phys. Rev.*, **8**, 149; 1916. *Proc. U. S. Nat. Acad.*, **3**, 141; 1917.
[4] *Astrophys. J.*, **69**, 7; 1929.
[5] *K. Sven. Vetenskap., Handl.*, 3, **13**, No. 2; 1934. (*Upsala Meddelande*, No. 58.)
[6] "The Earth", p. 250; 1924.
[7] *Mon. Not. Roy. Ast. Soc.*, **94**, 231; 1934.
[8] Cf. Schoenberg and Jung, *Astron. Nachr.*, 247, 413 (1933).
[9] Cf. Struve, Elvey and Keenan, *Astrophys. J.*, **77**, 274; 1934.
[10] *Mon. Not. Roy. Ast. Soc.*, **77**, 91; 1916.
[11] loc. cit.
[12] Cf. H. Jeffreys, loc. cit.
[13] Cf. G. v. Hevesy, "Chemical Analysis by X-Rays and its Applications". (Cornell University Publ. 1932.)

Deep Diving and Under-Water Rescue

SIR ROBERT DAVIS delivered the Thomas Gray Memorial Lectures for 1934 of the Royal Society of Arts, and spoke on deep diving and under-water rescue. The lectures have now been published; they form a valuable study of the development of apparatus and technique, admirably illustrated and lightened by comments and anecdotes arising out of the author's lifelong experience of the subject.

Divers have always wanted to get a little deeper, but the particular obstacle to be overcome has varied in successive generations. At first it was the matter of air supply, when the eighteenth century inventor and his victims "discovered by bitter experience that the leathern bellows, which worked so admirably when blowing an organ or smith's forge, were quite incapable of forcing air down to a diver" working at more than two or three feet deep. Later, when the introduction of metal air pumps enabled a supply to be delivered at high pressure, came the mysterious, crippling, 'diver's palsy' which we now call compressed air illness. Later still, when physiologists had elucidated the cause of this trouble and devised methods of slow decompression to avert it, came the economic difficulty that at depths of thirty fathoms and upwards, so much of the diver's time under water had to be used in decompression that only a fraction remained available for useful and paying work. Now the invention of the Davis Submerged Decompression Chamber (see NATURE, August 29, 1931) has eased this situation and made salvage work in the rubber dress a practical procedure up to 300 feet depth; and there for the moment we rest.

The deep diver of to-day receives a measured supply of clean air from steam compressors. An

injector circulates the air from his helmet through an absorbent which removes carbon dioxide as fast as his breathing produces it. He is in constant telephonic communication with the organisation in the salvage ship above, which not only controls his decompression but also, through the agency of such devices as grabs and pneumatic tools, takes over an increasing share of the manual work to be done on the bottom. Expensive plant, once started, should run continuously, hence a succession of fresh divers is required who have to subordinate their procedure to the common plan of the team. The famous divers of the past, some of whose feats Sir Robert described, worked almost single-handed in far greater danger and discomfort; only the fittest mentally and physically could attempt the deeper work and these few acquired outstanding skill and experience. It may be that we shall not see their like again.

More than fifty years ago one of these men, Alexander Lambert, struggled through 1,000 feet of the wrecked and flooded Severn tunnel in complete darkness to close an iron door and enable the water to be pumped out. As it was impossible to drag such a great length of air pipe behind him, he used H. A. Fleuss's newly invented self-contained diving-dress, putting it on for the first time that day. This was the prototype of the now familiar type of breathing apparatus in which carbon dioxide is removed from the expired air by passing it over caustic alkali, and the oxygen consumed by the user is replaced from a high pressure cylinder. This system is in use in mine rescue and fire brigade smoke helmet apparatus all over the world to-day, but has perhaps been carried to the highest point of development and portability in the compact Davis Submarine Escape Apparatus, which now provides each member of the crew of all British (and many foreign) submarines with the means of breathing in suffocating gases or under water until the escape hatches can be opened, when it will waft him gently to the surface and support him there until help arrives.

The Future of Tropical Australia

By DR. L. DUDLEY STAMP

FOR more than a century the British Government, the colony of South Australia, and the Australian Commonwealth have attempted to develop the half million square miles contained within the Northern Territory. More than £17,000,000 has been expended in the effort, yet to-day the entire population consists of some 3,000 whites, 800 yellow persons, 900 half-castes and probably 20,000 aboriginals. The mining and cattle industries, once promising, have declined. The same state of affairs is found in the tropical parts of Western Australia, where the total non-aboriginal population is less than 2,000. It is only on the patches of richer soil along the coast of Queensland that the population of tropical Australia is relatively flourishing and increasing.

A few years ago, Prof. Griffith Taylor[1] was almost alone in declaring that only three per cent of tropical Australia—entirely in the coastal belt of Queensland with its well-distributed rainfall—was suitable for tropical agriculture and consequent close settlement. His views are gradually becoming generally accepted, but there is still a wide divergence of opinion on the reasons for the lack of settlement. Sir James Barrett in a recent article[2] says, "It is generally assumed that there is a medical, or rather physiological, reason for failure to settle parts of tropical Australia. So far as investigation goes there is nothing of the kind. The failure to settle some parts of tropical Australia and the successful settlement of other portions of the tropics is solely economic." In his consideration, he rightly divides tropical Australia into four regions: (1) the coastal districts of Queensland with good soil and abundant rainfall; (2) the western portion of Queensland suitable for grazing; (3) the Northern Territory; and (4) the northern portion of Western Australia similar in character to (3). He shows that in the last ten years the annual increase of population in tropical Queensland has been 2 per cent per annum, against 1·5 per cent for non-tropical Australia. He finds that birthrate, infantile and general death rates in tropical Queensland compare favourably with those of many non-tropical countries, are better than those of metropolitan non-tropical Australia and are little if at all inferior to those of Australia as a whole.

It is, as Sir James argues, unfair to consider the vital statistics for regions (3) and (4) because of the small size of the sample. Economic nationalism and State socialism are blamed for preventing more rapid development of tropical Australia—"it is certain that it is not the effect of the climate on Anglo-Saxons". On the other hand, R. W. Cilento, director of Australian tropical hygiene, considers that the Commonwealth is evolving a new type of person—the North Queenslander—who "moves slowly and conserves his muscular heat-producing energy in every possible way"[3], thus agreeing with results of experiments carried out by American physiologists recently[4]. The

vital statistics quoted by Sir James Barrett prove the efficient work of the medical services rather than the absence of climatic influence on life and habits.

In a thoughtful and well-documented study[5], A. Grenfell Price, of the University of Adelaide, has reviewed the attempts to settle and establish agricultural or other industries in the Northern Territory. The thorough work of this geographer has been recognised by the award to him of the Commandership of the Order of St. Michael and St. George and the doctorate of the University of Adelaide in 1933. He has summarised his views on the major problem in a paper entitled "Pioneer Reactions to a Poor Tropical Environment"[6], and concludes that "there is little hope for anything more than a sparse pastoral population in the greater part of the Australian tropics and that this population will show strong reactions to a poor and difficult tropical environment. There is, however, some possibility that Australians may permanently establish close settlement by white agriculturists in small and favourable areas, particularly on the east coast of Queensland".

Dr. Isaiah Bowman[7] suggests that, so far as the Northern Territory is concerned, it would be better to "give up this painful experiment on an incorrigible frontier and let the land revert to wilderness".

If the land has now been properly assessed, the real danger of 'an empty north' to the 'White Australia' policy disappears. Sir James Barrett points out the accessibility of the Northern Territory from densely peopled areas, such as Java, and argues that had conditions been suitable it would long ago have been colonised by Malays or Javanese. On the other hand, there was not, perhaps, sufficient economic pressure to necessitate the inhabitants of the East Indies seeking settlement in lands less attractive. The position to-day is somewhat different. There is a close correlation between climatic and soil conditions in the region around Darwin and in some of the poorer parts of peninsular India. Will the future alter the value of tropical Australia in the eyes of overcrowded India? Darwin is clearly destined to remain on a major world aerial route, and in this connexion at least the Northern Territory cannot remain entirely empty.

[1] See *inter alia*, "Australia, Physiographic and Economic", Oxford. Third edition, 1923, pp. 262–3.

[2] "Tropical Australia", *Aust. Quart.*, No. 21, 64–72, March 1934.

[3] Quoted by A. G. Price, *Amer. Geog. Rev.*, **23**, 371, July 1933.

[4] D. B. Dill and others, "Physical Performance in Relation to External Temperatures". Fatigue Laboratory, Harvard University, 1931.

[5] "The History and Problems of the Northern Territory, Australia". Adelaide, 1930.

[6] *Amer. Geog. Rev.*, **23**, 353–371, July 1933.

[7] "The Pioneer Fringe". New York, 1932, p. 186.

Obituary

SIR ALFRED EWING, K.C.B., F.R.S.

JAMES ALFRED EWING, like many Scots who have become distinguished in the fields of literature and science, was a son of the manse. He was born on March 27, 1855, in Dundee, where his father was a minister of what was then called the 'Free Church of Scotland', his father having 'come out' in the Disruption of 1843. In the autobiographical section of "An Engineer's Outlook", Sir Alfred described his father as a man who, with a superb physique, never missed a day's duty through illness, or shirked one for any reason; the same words might be applied to Sir Alfred himself. He seems to have owed much of his early education to his mother. As he so happily phrased it, "She gave us much of what other boys got at school, and did it in a way that made us associate a love of learning with our love of her".

From Dundee High School, Ewing proceeded in the early '70's to the University of Edinburgh, the first holder of an engineering scholarship in the gift of Dundee High School, and his career as a student was prophetic of the distinction he was to acquire in later life—the records of the Engineering Department show that during the session 1871–72 the prizeman in the class of engineering was James Alfred Ewing. It was his good fortune to be a student during the time when Tait and Fleeming Jenkin were at the zenith of their powers, and undoubtedly Ewing owed much of his zest for research to the inspiring influence of these two teachers. Through Jenkin he was brought into contact with Sir William Thomson (afterwards Lord Kelvin), and he took an active share in the early development of submarine telegraph cables, making in connexion with this work three cable-laying voyages to Brazil and the River Plate.

In 1878, on the nomination of Fleeming Jenkin, Ewing went to Japan as professor of mechanical engineering in the University of Tokyo, and there spent what he termed "five educative years". In the latter part of this service one of his duties was to undertake teaching in physics, and he there began his classical experiments on magnetism.

It was while in Tokyo that Ewing married his first wife, Miss Washington, a great-great-grand-niece of the first president of the American Republic. He had two children, born in Japan, by his first wife, who reached mature years before their mother's death. In 1911, shortly before he was appointed to the principalship of the University of Edinburgh, he married as his second wife a daughter of the late Prof. John Hopkinson, a past-president of the Institution of Electrical Engineers, by whom he had a son.

After five years service in Japan, Ewing decided

to return home, although the Japanese authorities were anxious to retain his services for another two years. He had been offered, however, the professorship of engineering in University College, Dundee, and there he had seven years of further experience in teaching and research.

In 1890 Ewing was appointed to the chair of mechanism and applied mechanics in the University of Cambridge as successor to James Stuart. The last years of Stuart's occupancy of the chair had not been happy ones, as his attention had been largely diverted from engineering to politics and journalism, and the University was disinclined to continue the engineering department, if that were possible; fortunately, a wiser decision was taken. By the generosity of donors, Ewing soon acquired a laboratory, where research work could be carried on and ordinary laboratory instruction given. The school flourished, the number of students increased rapidly, and, in 1899, a generous gift in memory of Prof. John Hopkinson from his widow and children provided the funds for a much-needed enlargement of the laboratory buildings. By 1903, when Ewing severed his connexion with the University of Cambridge, the Engineering School was one of the largest in the country, and its output of research testified to Ewing's great influence upon those working with him.

In 1903, the Admiralty was about to introduce what was known as the New Scheme of Naval Education. After an interview with Lord Selborne and Sir John Fisher, Ewing was offered the post of Director of Naval Education on very generous terms. This opened up for him an entirely new sphere of work. It meant that he had for the time being to abandon his researches and to drop his professional practice. That this new scheme became a complete success was largely due to Ewing's extraordinary gift for administrative work, as there was opposition to some of the changes which had to be introduced.

When the War broke out in 1914, Ewing was still Director of Naval Education, but almost at once he was asked to undertake an entirely new and onerous duty, namely, the problem of dealing with enemy cipher. This led to the creation of a department which came to be known as "Room 40". The work carried out in Room 40 was strictly secret, and no section of our defence work was more unknown to the general public and to the enemy. The secrets of Room 40 have never been divulged, though Ewing himself removed the veil slightly in a lecture he gave before the Edinburgh Philosophical Institution in 1927. Prior to this, the late Lord Balfour, then Chancellor of the University of Edinburgh, disclosed the fact that Ewing had been the head of the organisation in Room 40.

It was while carrying on this work that Ewing was invited in 1916 to fill the dual office of principal and vice-chancellor of the University of Edinburgh. He was somewhat averse to undertaking this fresh burden, but was persuaded by the late Lord Balfour to accept office, while still continuing his work at Room 40, and it was not until May 1917, when he handed over the control to Admiral Sir Reginald Hall, that he was able to devote himself unreservedly to his University duties.

When he accepted office at Edinburgh, Ewing was sixty-two years of age, and it is a striking testimony to his extraordinary capacity for work and to his bodily vigour that, starting at that late age in an entirely new sphere of work, he was able in the twelve years of his principalship to accomplish such great and far-reaching changes in the development of the various departments of University life. He realised that the War had brought many new problems in education and industry, and that the great universities would have to play a very important part in the necessary solving of these problems. Rapid developments in specialised study made it essential to found new chairs and lectureships, and during his term of office at Edinburgh no less than thirteen new chairs were established—six in the Faculty of Arts, four in the Faculty of Medicine, and three in the Faculty of Science—besides a number of lectureships in new subjects or in some of the older subjects where the teaching had to be extended. A new degree in commerce was established; and the degree of Ph.D. was instituted in the hope of encouraging post-graduate work and research. The increase in the number of the teaching staff involved as a corollary an extensive scheme of new buildings. It was impossible to find a site for the necessary new buildings in the immediate vicinity of the Old College, and Ewing decided to recommend the purchase of a large area of ground about a mile and a half south of the Old College, where during his principalship independent blocks were erected for chemistry, zoology and animal genetics; while plans were prepared and finances provided for new blocks for geology and engineering, built, however, after he had retired. These blocks of buildings, known as King's Buildings, will remain as a permanent memorial to Ewing's term of office as principal of the University of Edinburgh.

Needless to say, such an extensive increase in the number of teaching staff and the erection of these buildings involved very heavy expenditure. Fortunately, Sir Alfred had a very persuasive tongue, and he was able to secure handsome gifts from private benefactors and public trusts, running into a total of more than three-quarters of a million sterling, and was thus able to carry through his improvement schemes without laying any serious burden upon general University finances.

During his twelve years of office, crowded as they were with administrative and social duties, Ewing was still able to find time to carry on research work, which had been his chief pleasure and object in life. He was an active member of many of the special committees of the Department of Scientific and Industrial Research, being chairman of the Bridge Stress Research Committee, which issued a valuable report in 1928. The necessary experiments on railway bridges throughout the country had to be carried out usually during week-ends, week-ends which an ordinary man at Ewing's age would have given over to rest and recreation, especially after he had

spent the previous five days in strenuous University work. He was also chairman of the Timber Mechanics Committee, and so recently as July 1934 that Committee issued a report, largely the work of Ewing himself. There can be little doubt that Ewing habitually overworked himself during the last three or four years of his life—work was his passion, especially research work, and it was to research work that he devoted his main energies during his last years.

It is interesting to remember that, as Ewing began his university career and his life's work more than sixty years ago in the engineering class-room of the University of Edinburgh, so he made his last public appearance in the lecture room of the engineering department only last October, when he delivered an address entitled "For Better or Worse" to the members of the Associated Science Societies of the University. How much he was beloved by the students of the University was attested by the fact that he was known to them by the affectionate nick-name of "Alfy", and, at the conclusion of his last address, after the formal vote of thanks had been proposed and carried, the student audience rose to its feet and gave, as only students can, three rousing cheers for "Alfy".

Ewing's last years were largely occupied by the thought that man's ethical development had not kept pace with the advance of science, that science and engineering had placed in the hands of mankind tools which man had not yet learned to use wisely. This formed the main theme of his remarkable presidential address to the British Association for the Advancement of Science at York in 1932. In "An Engineer's Outlook", published two years ago, one of the reprinted lectures was the Hibbert Lecture, delivered at the University of Cambridge in February 1933, on "Science and some Modern Problems". This lecture summed up Ewing's creed; after sixty years of active life in the service of education and science, he could find no better principle to urge on his listeners than the old gospel of goodwill—"*Thou* shalt love thy neighbour"—this, he said, is not a mere general injunction, it is an individual message.

Ewing was the recipient of many honours. He held honorary degrees of the Universities of Oxford, Cambridge, Durham and St. Andrews. He was elected a fellow of the Royal Society in 1887, and in 1895 received a Royal Medal for his researches on magnetism. He was elected an honorary member of the Institution of Civil Engineers in 1929, and of the Institution of Mechanical Engineers in 1932. He was made a Companion of the Bath in 1907, and Knight Commander of the same order in 1911. He was the author of many papers on scientific subjects, published in the *Transactions of the Royal Society* and other scientific societies. His textbooks include "Magnetic Induction in Iron and Other Metals"; "The Steam Engine and Other Heat Engines", of which many editions have been issued, and which has been translated into many languages; "The Mechanical Production of Cold", "Thermodynamics for Engineers" and "The Strength of Materials".

T. HUDSON BEARE.

Sir Alfred Ewing and his Cambridge Chair

The Jacksonian professorship of natural and experimental philosophy at Cambridge is an old foundation dating from 1783. It was the duty of the professor to give experimental lectures on "Natural Experimental Philosophy and Chymistry", and the chair had been held by a succession of distinguished men. In 1875 it was vacant through the death of Prof. Willis, who had been its occupant for nearly forty years. His predecessors had been chemists.

By 1875 it was recognised that the study of the natural sciences deserved fuller encouragement. Maxwell, a few years previously, had been appointed to the chair of physics. Foster was lecturing as a Trinity prælector, Frank Balfour was beginning his work on comparative anatomy, and Liveing was teaching chemistry to an ever-increasing number of students. It was clear that he needed help; the Jacksonian professorship again became a chemical chair and Dewar was invited to fill it.

At the same time, it was felt that mechanism and applied mechanics should still have a place in the University course; there was a man in Cambridge who could carry on some part at least of Willis's work, and so a professorship of mechanism and applied mechanics, to "terminate with the tenure of office of the professor first elected" unless the University should determine otherwise, was established, and James Stuart became professor. There were some, Coutts Trotter for example, who, even then, sixty years ago, realised that the scientific study of engineering was a fitting subject for inclusion in the scheme of an ancient university. It was a long step from this appointment to a professorship of engineering. It was to be the duty of the professor to lecture on the principles of mechanism; the theory of structures; the theory of machines including the steam engine and other prime movers.

There was an ordinary degree in mechanism and applied science, for which students were advised to read parts of Weale's Rudimentary Series, Balfour Stewart's "Heat", Bird and Brooke's "Elements of Natural Philosophy", and Ganot's "Physics". There was no laboratory, no provision for experimental work. But the professor started his work He raised funds for a certain amount of apparatus, some tools and workshop appliances, which ultimately were taken over by the University. A shed was erected to hold these, and by slow degrees the work grew.

Some ten years later (1886–87), there was much controversy as to the place workshops should hold in a scheme for an honours degree in engineering then under discussion. A syndicate appointed to investigate among other things the "whole question of the workshops" was granted, in 1890, "further powers to enquire whether it be desirable to develop further the Engineering School in the University on the lines suggested" in a memorandum it had issued, and as a result, on November 10, 1892, the Mechanical Sciences Tripos was established. The Tripos was to be in two parts covering the usual subjects of examination for an honours degree in engineering, together

with—an addition of 1895—a paper of essays having "reference to the fundamental principles, history, philosophy or applications of the Mechanical Sciences".

Meanwhile, Prof. Stuart had resigned and, to quote the "University Calendar", in "1890 J. A. Ewing, B.Sc. Edinb." had been appointed professor. He came, personally unknown to us, but with a distinguished career as a teacher at Tokyo and Dundee, a pupil of Lord Kelvin, the author of papers on magnetism of outstanding merit. In 1881 he had described the effects which follow the application of a cyclical process of magnetisation to iron and other material, that tendency of the magnetisation to lag behind the application of the magnetising force, to which he gave the name of *hysteresis*, and in 1885 had contributed a striking paper to the Royal Society entitled "Experimental Researches in Magnetism".

Ewing established himself at once as a *persona grata* to the University, a colleague, soon to be our leader, whom some of us who had been active in urging that engineering should receive full recognition from the University welcomed whole-heartedly among our ranks. To his wise judgment and sane advice are due the general acceptance of the scheme of education proposed. The debt due to him by the University may perhaps be measured by the success of that scheme which, aided by his staff, Peace and Dalby and Lamb, he developed for the next thirteen years.

A committee was set up in Cambridge to obtain funds for the establishment of an adequate laboratory for the teaching of engineering in the University. Sir J. J. Thomson, Prof. Newall, Sir Napier Shaw and myself are the sole survivors. Ewing was the treasurer. We had the help of a large and distinguished general committee which contained the names of all the great engineers of the day. We stated that £20,000 would be required for the complete design, but that much could be done for £4,000 or £5,000, and with the money so raised the Engineering Laboratory made its start. What it has now become engineers are well aware.

The first Tripos examination was held in 1896, Ewing, Osborne Reynolds, and Shaw were the examiners; seven candidates passed, of whom three were placed in the first class. Now the Engineering Tripos list is among the largest in the University.

Since those days, Sir Alfred has done more great work for his country. In Cambridge he will ever be remembered as the founder of the Engineering School, the man who taught the University what science, so long at home there, might do for industry and how that task might be achieved.

R. T. GLAZEBROOK.

Sir Alfred Ewing and Naval Education

THE connexion of Sir Alfred Ewing with naval education came about through the decision of the Admiralty, in 1902, to carry out a root and branch reform of the training of officers and men in all sections of the Navy. The reform was long overdue, for even up to 1901, junior officers spent a part of their time in learning to manœuvre ships under sail, although for all practical purposes sails in warships had been obsolete for thirty years. Then, too, there was the urgent problem of the staffing of the engine rooms of the steadily increasing fleet, a problem rendered difficult by the failure of successive Boards of Admiralty to adjust the status of naval engineers in accordance with their responsibilities.

Though at the beginning of the century, naval training was discussed in many quarters, the credit for the re-organisation of naval education in 1903 to meet modern requirements belongs in the first place to Lord Fisher (then Admiral Sir John Fisher), who had recently become First Sea Lord. The first step in the reform was the publication in December 1902, over the signature of Lord Selborne, of the famous "Memorandum dealing with the Entry, Training and Employment of Officers and Men of the Royal Navy and of the Royal Marines". That memorandum stated that "In the old days it sufficed if a naval officer were a seaman; now he must be a seaman, a gunner, a soldier, an engineer, and a man of science as well"; and that "the three branches of the Service which are essential to the fighting efficiency of the Fleet—the Executive, the Engineer and the Marine" were to be recruited by one system and all officers were to be trained alike up to a certain age.

These were ideas entirely new to the Service and to carry them into effect it was obvious that the Admiralty would require a man of outstanding reputation. Their choice fell on Sir Alfred Ewing, who in the preface to his book, "An Engineer's Outlook", tells of his first visit to the Admiralty, when he met Lord Fisher, "that volcanic personality whom, later, I was to see often in quiescence and in eruption, and to learn something of his greatness". This visit led to Lord Selborne offering Sir Alfred the appointment of Director of Naval Education.

To a civilian, the task Sir Alfred undertook might well have appeared a complex one, for in the course of a few months he found himself responsible for the training given in the Royal Naval College, Greenwich, H.M.S. *Britannia*, the new Royal Naval College at Osborne, the Royal Naval Engineering College at Keyham, the Dockyard Schools at Portsmouth, Chatham and Devonport, various training establishments for seamen, stokers and artificers, together with the supervision of the work of some eighty naval instructors of university standing, many of whom were serving on distant stations. The Selborne-Fisher scheme naturally cut across many traditions and found not a few critics; while from the members of the Board of Admiralty Sir Alfred received every assistance, among those below them he was sometimes conscious of cross-currents.

From the beginning it was realised that the new system of training would have to be modified in the light of experience, and many changes have been made. It may, however, safely be said that naval education to-day owes more to the work done by Sir Alfred Ewing between 1903 and the War than to any other single individual.

EDGAR C. SMITH.

News and Views

Mr. Lloyd George's Plans for National Development

MR. LLOYD GEORGE, outlining at Bangor on January 17 his proposals for national development, said that the supreme paradox of our generation is that millions of people are living in poverty and despair, not because of scarcity but because of over-abundance. Foremost among the problems of to-day and to-morrow is the question of securing peace among the nations, since whatever economic and social system is built up, unless it is based on peace, it will be founded on a quicksand. Next there are the obstacles to world trade, commerce and shipping which have multiplied enormously in the last few years. We are to-day confronted with a twofold problem, first of temporary unemployment due to abnormal conditions, and secondly of permanent unemployment which cannot be absorbed under the existing system. Our aim should be to find work for the workless instead of providing doles, and where private enterprise has been proved to be palpably unable during the present emergency to solve our national difficulties, the administrative and financial resources of the nation as a whole should be made responsible for setting on foot and supporting those developments in town and country which would bring our unutilised labour, our idle capital and our undeveloped resources into fruitful activity. Something on these lines has been attempted here and there—in housing, roads and other public works—but where it has been done, it has been done sporadically and inadequately.

MR. LLOYD GEORGE'S main proposal is that a permanent body should be set up for the purpose of thinking out and preparing schemes of reconstruction which would provide useful and necessary work. The functions of this Development Council would be to take a survey of the industrial, agricultural and financial resources and potentialities of Great Britain; to prepare and approve plans for industrial organisation, land development and the like; and to concede the application of the national credit with the view of properly financing the programmes it decides to carry out. Its duties would include the putting forward of recommendations to enable any important branch of industry, such as coal, cotton, iron and steel, shipping or agriculture, to re-organise itself, where the authority and the financial credit of the State may be needed to ensure proper measures being taken. Further scope for its activities would be found in meeting the lamentable deficiency of decent houses; in road improvements; in the development of railways and canals; in the development of telephones, electricity and water supply and in land settlement. Mr. Lloyd George also advocates a fundamental change in the constitution of the Cabinet. In an emergency like this, the Cabinet should consist of a small body—not more than five—of the ablest men available and not of about twenty men immersed in the detailed administration of gigantic departments of State.

General G. Ferrié (1868–1932)

THIS great and singularly attractive man died so long ago as February 16, 1932, but we did not succeed in obtaining an obituary notice of him. Many of our readers who knew him or his work will therefore be interested to learn of a series of eulogies and accounts of his life (*Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, **133**, Oct. 1934, pp. 533–564). They include a funeral oration broadcast from Paris on the day of his death by Lieut.-Col. P. Brenot; a discourse given at his funeral two days later by M. R. Bourgeois, president of the Paris Academy of Sciences; a lecture on March 10, 1932, to an association of Engineers' regiments, by Lieut.-Col. P. Brenot; discourses by General Perrier and M. Painlevé (then Air Minister) at the inauguration of the plaques bearing the title of the newly-named Avenue du Général-Ferrié, at the Champ du Mars, October 10, 1932; a discourse of November 15, 1933, by M. Emile Picard, at the inauguration of a monument to General Ferrié, near the radio-telegraphic station at the Champ du Mars; a discourse by M. René Mesny, November 17, 1933, at the Academy of the Marine; and discourses by MM. J. Paraf and de Valbreuze, at the inauguration of a memorial medallion at l'École supérieure d'Électricité, Malakoff (Seine), where General Ferrié for many years gave and directed instruction in radio-telegraphy.

BORN in Savoy in 1868, Ferrié entered l'École Polytechnique in 1887 and was sub-lieutenant in the 'Engineers' in 1889, specialising in telegraphy in 1893. His introduction to radio-telegraphy came in 1898, when he studied the Hertzian waves after the publication of Marconi's first experiments. In 1899 he assisted in Marconi's famous experiments in radio-communication between Folkestone and Boulogne, and shortly afterwards was appointed by the Minister of War to develop the military applications of this new mode of communication. For many years he carried out this task with very little material or financial support, and battled magnificently against official inertia and incredulity. Gradually his ability, his faith, his energy, his initiative, his organising power, his devotion, led to successes which gained for him growing recognition and support. He built up a military radio organisation, first tested in the Morocco campaign of 1908, in which he took part, and enormously and most effectively expanded during the War of 1914–18. In 1903 Ferrié instituted the radio station at the Eiffel Tower, whence, later, in conjunction with the Paris Observatory, he transmitted the time signals which have played so important a part in subsequent progress in time and longitude determination. After the War, Ferrié took a most honoured place in international scientific work, being president of the International Commission of Longitudes by Radio-Telegraphy, and of the International Union for Scientific Radio-

Telegraphy. He was honoured in very numerous ways by scientific bodies in France and in other countries. In 1930, by a special law, he was made General for life, a signal testimony to the place he had attained in the esteem of his country. Not only was he respected and admired for his ability and power, but also all who knew him loved him for his courtesy and his goodness of heart.

Bequest for Bacteriology at Edinburgh

MRS. CAMERON, widow of Lieut.-Col. Lewis Cameron, Indian Medical Service, who died at St. Helier, Jersey, in 1930, bequeathed all her estate and effects to the University of Edinburgh and directed that the fund, to be known as 'The Lewis Cameron Fund', should be utilised in establishing a yearly prize for the best paper on bacteriology or on the diagnosis of disease by students of the University. The estate amounted to £103,771. This amount was regarded by the University as out of proportion to the purpose of the bequest. The University gave an undertaking to Mrs. Cameron's executors that they would make application to the Court of Session for a scheme for the regulation of the purposes affecting the estate, and on January 14 the Court approved the administration of the fund as follows: £3,000 for the establishment of two yearly 'Lewis Cameron' prizes of £50 each, one open to undergraduate students and the other to post-graduate students of the University for the best papers on subjects related to bacteriology or to the diagnosis of diseases; £15,000 for the endowment of a 'Lewis Cameron' teaching fellowship in bacteriology; £15,000 to stabilise by endowment one of the existing lectureships in bacteriology; £10,000 to form a 'Lewis Cameron' research fund, and £10,000 for a 'Lewis Cameron' library fund to provide books relating to bacteriology and the diagnosis of disease. The remainder of the estate, about £50,000, is to be set aside as the nucleus of a building fund for providing additional accommodation and equipment in the University for teaching of the sciences bearing on the diagnosis of disease and for research in these sciences. It is hoped that allocation of this sum for buildings may enable the University to obtain assistance from other sources, and so make possible an extension of the medical buildings and of their equipment necessary to maintain the reputation of the University as a centre of medical education and research.

Exhibition of Primitive and Chinese Art

Two exhibitions of objects of art are being arranged for this year, which will be of no little scientific, as well as æsthetic, interest. Of these, the first will illustrate the art of primitive peoples. This exhibition will take place in May next and will be held under the auspices of the Burlington Fine Arts Club. Although the various schools of primitive art, if that term may be used, are well, and on the whole fully, represented in the national and public collections, examples must as a rule be subordinated to the general scheme of museum arrangement, and other material distracts from their proper appreciation. If, as no doubt will be the case, representative series are shown, their close association within the compass of a single exhibition should lead, by force of comparison and contrast, to an extended perception among the general public of the variety of primitive art in ideals, technique and achievement, as well as to a clearer understanding of the part played by artistic products in relation to the life and mentality of the peoples who have produced them. On the other hand, it may be anticipated that the primitive will not be without effect on the more sophisticated culture. The influence of African art in wood and ivory carving on the development of modern schools of art in painting and sculpture early in the present century will serve as a reminder that primitive art is not without something more than antiquarian interest in the theory of æsthetic.

THE second exhibition is of an entirely different character and will be the product of international co-operation on an extended scale. The Royal Academy has arranged to hold an exhibition of Chinese art from November 1935 until March 1936. The King and Queen and the President of the Chinese Republic will be patrons, and the exhibition will be held under the auspices of the British and Chinese Governments. As it is intended that the exhibition should illustrate fully the art and culture of the Chinese from early times down to 1800, a unique opportunity will be afforded for placing China in something like true perspective in the history of world civilisation. The art of China, as is well known, played no inconsiderable part in the development of the art and culture of Western Europe from the eighteenth century onward; but this was only at a late phase in a remarkably long line of development. In this exhibition the association of 'classical' with the products of early and prehistoric culture, especially in the instance of the last-named of the more recently discovered, to which additions are being made continuously, will serve as a much-needed corrective of some popular misconceptions of the standing and achievement of the Chinese as a people. It may possibly also serve the useful purpose of stimulating a more active interest in their own antiquities among the Chinese themselves. An influential organising committee has been appointed with Lord Lytton as chairman, and Mr. Laurence Binyon, Mr. R. L. Hobson, Sir Neil Malcolm, M. Paul Pelliot and Prof. Perceval Yetts among its members. This committee will co-operate with a local Chinese committee of State officials under the presidency of the Minister for Education in the selection of exhibits from China. Other exhibits will be drawn from collections in Japan, Europe and America.

History of Dyestuffs in Great Britain

MR. C. T. J. CRONSHAW, director of the Dyestuffs Section of Imperial Chemical Industries, Ltd., is this year's Jubilee Memorial lecturer for the Society of Chemical Industry, and he spoke under the title "In Quest of Colour" before a joint meeting of that society with the Institute of Chemistry in Newcastle

on January 15. This proved to be a comprehensive account of the history of the dyestuffs industry in Great Britain, and traced the development and expansion of the chemist's skill and the dyer's needs since Sir W. H. Perkin's original discovery in 1856. Perhaps the most interesting section of the address was the examination of the causes which produced the rise, and then, in England, the decline of the new manufacture. In the first place, the time was ripe for such a discovery because the successful application of machinery to the textile industries and the increase in available wool (from Australia) offered almost unlimited expansion, and also as England was a wealthy country and the workshop of the world. As for the decline, Perkin himself attributed it to three causes: the Patent laws, the ease of infringement abroad, and foreign import duties. Others have blamed the textile manufacturers and the greater facilities for scientific publication in Germany at that time, but Mr. Cronshaw placed above these, lack of foresight, and the fact that the leaders of the industry retired too soon. Perkin was certainly the leading technologist of his day, and he retired at the age of thirty-six years, Caro at thirty-five in 1869, and Nicholson in 1868. Perhaps the early success was too easy, and proved to be dearly bought.

Queen Maud Ranges of Antarctica

THE American expedition to the Bay of Whales in the Ross Sea is reported by *The Times* to have undertaken a most successful dog-sledge expedition to the Queen Maud Ranges, which amplifies the work of Dr. L. M. Gould of the previous Byrd expedition of 1929–30. A party of three under Mr. Q. A. Blackburn reached the Thorne glacier, which lies in about lat. 86° S., long. 153° W., and then ascending the glacier reached the surface of the polar plateau at an elevation of about seven thousand feet. The ranges appear to continue with decreasing heights to the north of east. This direction may lead to Coats Land in the Weddell Sea or possibly towards Hearst Land. At the top of the glacier, deposits of coal are reported to have been found. This would appear to be the same deposit found on the Beardmore glacier and the carbonaceous layer found in the flank of Mount Nansen. There is thus a confirmation of the suggestion made some years ago by Sir Edgeworth David of a great coalfield associated with the Beacon sandstone of the polar plateau. The brief cabled report also refers to a subplateau at an elevation of 2,500 ft. between the Ross Sea ice and the level of the polar plateau. This was called the Leverett glacier in 1929. The sledge party reached three degrees from the Pole before turning back, and altogether covered 1,410 miles in 88 days.

Effect of Rough Seas on Marine Structures

ON February 2–3, 1934, a storm of exceptional severity was experienced along the northern coast of Africa and led to the destruction of more than 1,300 ft. of the recently constructed Mustapha Breakwater at Algiers. The storm and the damage done is described by Dr. B. Cunningham in *Engineering* of January 11. There are several moles protecting the Port of Algiers, but whereas the older ones are rubble mounds, the Mustapha Breakwater consisted of a vertical wall 11 m. thick with its base resting on a rubble foundation 50 ft. below mean sea-level. It was recognised as one of the finest examples of its kind. The wall successfully withstood a severe storm on December 31, 1933, when it was subject to waves 6–6½ m. in height and 100–120 m. in length, but was completely destroyed by the storm of February 2–3, 1934. Observations made during this storm showed that the wall was being subject to the action of waves 9 m. in height, 200 m. long and with a period of 13¾ seconds, and photographs taken show unbroken masses of water 2–6 m. thick passing over it. There were three stages in its destruction: (1) erosion of the bed of the sea in front of the rubble foundation, (2) the sudden removal of the rubble foundation by one or more great waves, and (3) the excavation by the sea of a trench into which the wall collapsed. It has been generally thought, says Dr. Cunningham, that a level of about 40 ft. below the sea-surface marked the limit of appreciable dislocation of rubble foundation mounds by wave action, but this view now needs reconsideration, and it is clear that the effective suction of a back draught following wave stroke may extend to depths far below the accepted standard. Fortunately, the failure of the mole did not lead to damage to shipping in the harbour. It has now been decided to replace the wall at once with a breakwater of the classic mound type.

Removal of Smoke and Acid Constituents from Flue Gases

PRACTICAL remedies for preventing or reducing the emission of objectionable constituents in flue gases have in the past been mainly confined to the elimination of grit and dust emission. In large urban areas it is now realised that the acid emission is attended with more serious consequences. In 1927, Parliamentary sanction was only given to the erection of Battersea Power Station on the condition that the best practicable means should be taken to remove the oxides of sulphur from the flue gases. In a paper on a new method of removing smoke and acid constituents from flue gases read on January 7 to a joint meeting of the Institute of Fuel and the Institution of Electrical Engineers by Dr. J. L. Pearson, G. Nonhebel and P. H. N. Ulander, it was stated that the daily combustion of 1,000 tons of average coal in addition to grit, dust and tarry matter, leads to the formation of 45 tons of sulphuric acid, 3–7 tons of nitric acid and half a ton of hydrochloric acid. It is clear that when wet washing is applied, a non-effluent system must be used. The new system is a recirculating, non-effluent water system, from which the grit, dust and ashes are separated and removed as solids. A pilot plant was erected at Billingham, and was subjected to a twenty-months' running test. The water used was a hard surface water drawn from a local stream. Lime was used as the alkali for most of the test, and chalk was used for the remainder. Very satisfactory results were obtained. 97–99 per cent of the sulphur oxides

were removed, 90–93 per cent of the hydrochloric acid and 97–98 per cent of the grit and dust from the pulverised fuel boiler. The exit gas from the plant is so free from sulphur dioxide that it is practically odourless, although the sense of smell can detect a very minute trace of this gas.

River Flow Records

THE paper on "Flow of the River Dee" (Aberdeenshire), by Capt. W. N. McClean, read before the British Association meeting at Aberdeen last September, has been issued in pamphlet form, reprinted from *Engineering*, with a memorandum which indicates the progress made in the survey of the river subsequent to the original date of the paper, and an addendum illustrating the manner in which the records are to be set out in tabular form for publication. The Dee has a catchment area of 790 sq. miles to Aberdeen, and for the purposes of the survey it was divided into four subsidiary areas, with flow-gauging stations at Balmoral, Dennet, Cairnton and Cults. The author states that he has found that the summer flow in certain Scottish rivers of about 100 to 700 sq. miles catchment, may be taken, roughly, as from 1/5 to 1 cu. ft. per sec. per sq. mile, according to area. Flood flows are much more complicated. The author further notes the difficulty of measuring low flows with current meters, as they are at present not very reliable for velocities of less than 1 ft. per sec. He suggests the difficulty may be overcome in the future by a temporary contraction of the channel, so as to increase the velocity. Two types of apparatus are in use on the Dee : namely, one in which the meter is suspended from a wire and another in which a rod is the means of support. It is known that, in turbulent flows, the wire-suspended meter tends to set to the current and to give excessively high values. The combined use of the two methods enables a serviceable comparison to be made of their respective accuracies. The records obtained should prove of great public utility and the co-operation of two authorities directly interested, the City of Aberdeen and the Fishery Board of the Dee, has been secured in establishing the gauging stations. Capt. McClean points out that if there were a recognised association for these river records, the water interests would become subscribing members of the association, receiving the completed records in return for the standard tables of water levels prepared by themselves.

Thunderstorms in Great Britain

THE third annual report of the survey of thunderstorms in the British Isles, entitled "Summer Thunderstorms", has been received (Huddersfield : Thunderstorm Census Organisation. 2*s*. 6*d*.). Much of it has been written by Mr. S. Morris Bower, the honorary director of the Survey, but articles have been contributed by Sir C. V. Boys on "Progressive Lightning" and by S. T. E. Dark on "Trees Struck by Lightning". The Survey is an amateur enterprise somewhat similar to what the British Rainfall Organization was in its early stages. Its development is doubtless made more difficult because the economic importance of the distribution of thunderstorms is, at present, less than that of rainfall. There is the further difficulty that the study of thunderstorms cannot be effectively prosecuted apart from the general study of synoptic meteorology, except in limited directions. In the purely statistical problem of obtaining the best possible cartographical representation of the occurrence of thunder, the Survey had the advantage in 1933 of a number of voluntary observers—1,291—nearly four times greater than the number of full climatological stations co-operating with the Meteorological Office, an advantage greater than the numbers alone suggest in that the observers at official stations do not concentrate on one phenomenon. This report deals with some of the statistical results obtained in 1933, and also includes maps showing the number of days on which storms occurred in different parts of the British Isles in each of the months April–September 1932. The frequencies shown give the number of civil days during which one or more thunderstorms pass overhead, and are therefore not comparable with figures based on the international definition of a day of thunderstorm at any place as one on which thunder is heard at that place. The article on "Trees Struck by Lightning" is accompanied by some interesting photographs showing spiral scoring of tree trunks ; it can be seen that the lightning may descend the tree either in a left or a right hand spiral. Sir C. V. Boys's article deals with photographic studies of the duration and length of individual flashes, their direction and velocity, and suggests means for initiating a flash by firing a rocket into the thunder cloud, to assist in studies of this kind.

The Imperial Forestry Institute, Oxford

IN the tenth annual report of the Imperial Forestry Institute for the year 1933–34 (Oxford : The Holywell Press Ltd., 1934) it is stated that the number of students was still considerably below normal, owing to the stoppage of the recruitment for the forest services of the Colonial Office, though it compared favourably with the number of the previous year. Apart from regular students, a number of forest officers, at home on leave, and others attended the Institute for short periods to work in the libraries and the laboratories. The Institute is still short-handed so far as the staff is concerned. During the year, a decree was passed by the University allocating a site within the Parks area for the erection of a new building for the Department of Forestry, including the Imperial Forestry Institute. Some progress has been made in regard to preliminary plans and estimates for the building ; but it has not yet been possible to commence building operations owing to lack of sufficient financial provision ; this matter, it is said, is receiving further attention. The income of the Institute is made up of grants from the Crown Agents, Dominions and others, Forestry Commission, and the Department of Scientific and Industrial Research. An interesting part of the report is given

to a record of the progress which is being made with the collection and identification of the species of the forest floras of the various Colonies and Protectorates. Details are given under the Colonies grouped under West Tropical Africa, East Tropical Africa, South Central Tropical Africa, the South Temperate Region and a few other territories. The report gives full details of the various branches of work upon which the Institute is engaged, including brief accounts of the tours abroad undertaken by the students and others attending the courses.

Plant Breeding in the U. S. S. R.

THE Bureaux of Plant Genetics at Cambridge and Aberystwyth have published jointly a bulletin of 58 pages (price 3*s*. 6*d*.) on plant breeding in the Soviet Union. This is mainly a translation from the Russian of an address given by Prof. W. I. Vavilov at a conference on the planning of plant breeding and genetics investigations, held at Leningrad in 1932, and is followed by a detailed programme of work on different economic plants. The congress effected a reorganisation of the various genetical institutions in Russia and the adoption of a new system of fourteen plant breeding centres. This bulletin will be of service to all who are engaged in plant breeding, particularly on the practical side. It sets forth in outline the immense collections of economic plant material which have been made by expeditions to many parts of the world, notably Afghanistan, Kashmir, Abyssinia, Mexico, Bolivia and Peru. These embrace more than 200 crops, including 29,200 living specimens of wheat, 13,000 of barley, more than 9,000 of maize, 1,000 of potatoes, etc. There has resulted the conception of geographical centres for the production of varieties of many crops. The work includes cereals, vegetables, fruit trees, medicinal and fibre plants, etc. A series of new potato species with diverse characters and multiple chromosome numbers was found in the Andes. The vast amount of breeding work in progress and projected during the second five-year plan (1933–37) is outlined in the latter part of the bulletin.

Grassland Research

THE Imperial Economic Committee has issued its report (No. 27) on grassland seeds (London : H.M. Stationery Office. 1*s*. net). As grass may be regarded as the vital raw material of most of the produce of livestock, and farming and grassland products accounted for more than 20 per cent of the value of all imports into the United Kingdom in 1932, the importance of good grassland management cannot be overemphasised. The discovery that local strains are, for their own locality, often superior to commercial strains as regards persistence and leafiness has opened the way for considerable improvements, but even greater advances are being made by the production of pedigree strains at the plant breeding stations. If, however, economic benefit is to be gained from all this experimental work, far-reaching changes in organisation of the seed industry will be needed. The primary task is that of ensuring an adequate supply of stock seed of the pedigree strains and of maintaining them true to type when they pass in commercial quantities through the ordinary channels of trade, and to achieve this end the breeding stations will need to be supplemented by seed farms. In this connexion, the report gives particulars of schemes for seed certification and other methods which have been adopted in various countries, notably in Sweden, Canada and New Zealand, and the success with which such schemes have met suggests that districts such as Northern Ireland, where considerable quantities of rye-grass seed are produced annually, might benefit from a similar type of organisation if combined with the experiments now in progress with improved stock seed.

Farm Pumps

AN illustrated booklet entitled "Pumps for Farm Water Supply" by C. A. Cameron Brown of the Institute for Research in Agricultural Engineering, Oxford, has just been published (Oxford Univ. Press, price 1*s*. 6*d*.). Its appearance is opportune although plans for its preparation were made before the drought in 1933 and 1934 had rendered the question of rural water supplies such an urgent matter. The inquiry has been carried out particularly with the view of helping the farmer and isolated small country house dweller to obtain an adequate water supply from whatever source may be available at as low a cost as possible. Small electrically driven pumps capable of delivering upwards of 250 gallons per hour are available at prices from £10 to £12. No pump should be installed without an assurance from the makers that it will give the performance required to meet the particular set of conditions in each particular case, but with this proviso they should prove entirely reliable. The gravity tank is still the commonest, and probably the simplest, method of providing service, but the pressure-tank system has an advantage where the installation of a gravity tank presents constructional difficulty or is likely to be unsightly, but it is at a disadvantage in districts where electricity supply failures are frequent. The actual running cost of these small pumps is low in comparison with the cost of public water supply in towns. Test figures under working conditions show from 0·66 electrical units to 1·89 units per 1,000 gallons.

Zoological Society of London

AT the monthly general meeting of the Zoological Society of London it was stated that the total number of visitors to the Society's Gardens during the year 1934 was 1,639,611, the receipts amounting to £50,969, an increase of £3,432 as compared with the previous year. The total number of visitors to the aquarium during 1934 was 265,604; the receipts amounted to £9,063, which represents an increase of £242 as compared with 1933. The total number of visitors to Whipsnade Park during 1934 was 516,411; the receipts were £22,223, an increase of £3,463 as compared with the previous year.

Books on Agriculture

THE literature devoted to agriculture and allied sciences is now so extensive that the recent issue by the Ministry of Agriculture of Bulletin No. 78 entitled "A Selected and Classified List of Books on Agriculture" (6*d*. net) will be very widely welcomed. The books listed, together with many others, English and foreign, and many sets of periodicals, pamphlets and bulletins of agricultural experiment stations from all parts of the world, may be freely consulted in the Ministry's Library at 10 Whitehall Place, S.W.1, between the hours of 10 a.m. and 5 p.m. (Saturdays, 9.30 a.m. and 12.30 p.m.).

Announcements

WE regret to announce the death on January 16, at the age of seventy-nine years, caused by an accident while crossing a road in London, of Dr. F. A. Dixey, F.R.S., formerly subwarden, bursar and lecturer of Wadham College, Oxford, and president of the Entomological Society in 1909–10.

ON February 5, Brigadier M. N. MacLeod becomes director-general of the Ordnance Survey Department, Southampton, in succession to Brigadier H. St. J. L. Winterbotham, who has held the post since August, 1930.

PROF. E. V. APPLETON, Wheatstone professor of physics in King's College, London, has been elected a corresponding member of the Prussian Academy of Sciences (Physico-Mathematical Class).

PROF. OTHENIO ABEL, lately professor of palæontology and palæobiology in the University of Vienna, has been appointed ordinary professor of geology and palæontology in the University of Göttingen, and director of the Geological and Palæontological Institute and Museum of the University.

THE Progress Medal of the Royal Photographic Society of Great Britain has been awarded to Mr. Harold Dennis Taylor in recognition of his inventions, researches and publications in optical science, which have resulted in important advances in the construction of photographic lenses and in the development of photography.

THE Council of the Institution of Naval Architects has awarded the gold medal for the year 1934 to Vice-Admiral Y. Hiraga, professor of naval architecture and applied mechanics in the University of Tokyo, for his paper "Experimental Investigations on the Resistance of Long Planks and Ships", and the premium to Prof. B. P. Haigh, of the Royal Naval College, Greenwich, for his paper, "Further Tests and Result of Experiments on Electrically Welded Joints in Ship Construction". The medal and premium will be presented at the opening of the annual general meetings on Wednesday, April 10, at the Royal Society of Arts, John Street, London, W.C.2.

AT a reception given at the Collège de France on January 6, to the Assemblée de Médecine générale, addresses in memory of Claude Bernard, who made physiology the foundation of medicine, were delivered by Profs. Mayer and D'Arsonval. A visit was afterwards paid to Claude Bernard's laboratory in the Collège de France, where his table, instruments, early writings and manuscripts of his works are preserved.

AT the annual general meeting of the Royal Meteorological Society held on January 16 the following officers were elected : *President*, Lieut.-Col. Ernest Gold ; *Vice-Presidents*, Prof. David Brunt, Dr. A. Crichton Mitchell, Dr. F. J. W. Whipple and Mr. W. M. Witchell ; *Treasurer*, Mr. R. A. Watson Watt ; *Secretaries*, Dr. John Glasspoole, Mr. Eric Ludlow Hawke, Mr. M. McCallum Fairgrieve ; *Foreign Secretary*, Mr. Charles J. P. Cave ; *New Members of Council*, Mr. E. G. Bilham, Mrs. Charles J. P. Cave, Mr. C. S. Durst, Sir Gilbert Walker.

AT the meeting of the Royal Microscopical Society on January 16, the following officers were elected : *President*, Prof. W. A. F. Balfour-Browne ; *Vice-Presidents*, Mr. J. E. Barnard, Mr. Conrad Beck, Mr. D. M. Blair, Dr. R. S. Clay ; *Hon. Treasurer*, Mr. C. F. Hill ; *Hon. Secretaries*, Prof. R. T. Hewlett, Mr. J. Smiles ; *New Members of Council*, Mr. M. T. Denne, Dr. G. M. Findlay, Dr. E. E. Jelley, Mr. J. Milton Offord ; *Hon. Editor*, Dr. G. M. Findlay ; *Hon. Librarian*, Dr. Clarence Tierney ; *Hon. Curator of Instruments*, Mr. W. E. Watson Baker ; *Joint Hon. Curators of Slides*, Mr. N. I. Hendey, Mr. E. J. Sheppard.

THE Jenner Memorial Medal for 1934 has been awarded to Sir George Buchanan, vice-president of the League of Nations Health Committee and Master of the Society of Apothecaries of London, 1934–35. The Jenner Memorial Medal was founded by the Epidemiological Society (now merged in the Royal Society of Medicine as the Section of Epidemiology and State Medicine) in "recognition of the greatest medical service ever done to man", in 1896 on the occasion of the Jenner centenary. It is awarded by the Council of the Royal Society of Medicine on the recommendation of the Section for distinguished work in epidemiological research or for pre-eminence in the prevention and control of epidemic disease.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—An agricultural organiser for the Wiltshire County Council—The Clerk, County Offices, Trowbridge (Jan. 31). An assistant for research on bonding materials in foundry sands in the British Cast Iron Research Association—The Director, 21 St. Paul's Square, Birmingham, 3 (Feb. 8). A senior lecturer in physics, two lecturers in mechanical engineering, an instructor in workshop practice and drawing, and an instructor in carpentry, building construction and geometry at the Lester School and Institute, Shanghai—The Lester Trust, Messrs. Viney, Price and Goodyear, Empire House, St. Martin's-le-Grand, London, E.C.1 (Feb. 25).

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. 153.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Artificial Radioactivity Produced by Neutrons

IN the course of recent work in radium beam therapy research, we had the opportunity of making investigations in artificial radioactivity induced in some of the heavier elements through the agency of neutrons.

We had available a tube containing 500 mgm. of radium mixed with 2 gm. of finely divided beryllium. This source, and the element to be made radioactive, were immersed in a water bath to obtain the intensification of activity reported by Fermi and his co-workers, and interpreted by them as being due to neutrons slowed up by impact with the hydrogen nuclei of the water. The strong source used, and this method of obtaining intensification, permitted us to measure half-lives with fair accuracy in the case of elements previously reported weakly active. The following results were obtained:

Molybdenum	(1)	25 minutes
	(2)	Roughly 36 hours
Palladium	(1)	14 hours
Tantalum		Very slight activity after exposure for 24 hours
Tungsten	(1)	23 hours
Platinum	(1)	36 minutes

The distribution of slow neutrons around the 500 mgm. source immersed in 60 litres of water was studied by measuring the activity excited in a silver tube. Between 5 cm. and 10 cm. from the source, the activity fell off as the inverse first power of the distance, while between 15 cm. and 30 cm. the activity fell off roughly as the inverse fourth power. The edge of the water bath was about 30 cm. from the neutron source. This may account for the rapid falling off observed at the greater distance. The slowed up neutrons could not be detected 2 seconds after the source was removed.

We also had available three small tubes each containing 100 mgm. of radium. In one there was 100 mgm. of beryllium; in a second 100 mgm. of boron; and in the third 100 mgm. of aluminium. In each case the metal was finely divided, and was intimately mixed with the radium associated with it. The radioactivity produced in iodine by each of the three tubes was compared, with the following results:

	Neutron source	Activity excited in iodine (relative)
Tube 1	Radium and beryllium	13·0
Tube 2	Radium and boron	4·5
Tube 3	Radium and aluminium	1·0

The activity produced in a silicon tube by the smaller radium and beryllium source was measured under similar conditions in air and in water. The water reduced the activity by a factor 0·6, in contrast to its effect with silver, when a great increase in activity occurred. The thickness of water between the neutron tube and the concentric silicon tube was 1·4 cm.

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A Spectroscopic Method for Detecting some Forms of Chelation

ABNORMALLY large differences in solubility and volatility between isomers of some disubstituted benzene derivatives have been explained by Dr. N. V. Sidgwick as arising from the presence of chelate rings in the anomalous compounds. These rings are considered to be formed between ortho substituents and usually to contain six atoms, one of which is hydrogen situated between two oxygen atoms. The ease with which such rings can be ruptured has prevented a demonstration of the phenomenon by the usual methods of organic chemistry. In the course of a quantitative study of the infra-red absorption coefficients of a series of organic molecules, which is in progress in this laboratory[1], an apparently specific behaviour has been found for this type of chelated compound.

Organic molecules containing OH, NH, SH or CH show, in the near infra-red, absorption which is characteristic of the presence of these groups. Two illustrative spectrographic records of absorption due to the presence of OH, NH and CH are contained (on p. 3575) in the first report[1] of the above mentioned research. In these studies, on which a second report is now being prepared for publication, it has been found that the absorption (area under the absorption coefficient against frequency curve) in the vicinity of 1·4–1·6 μ due to one NH or to one OH group, shows variations which are not very large even among molecules of widely different types. These variations are, however, by no means negligible. Actually the difference in area so far observed is such that the largest is less than three times the smallest. Since, however, in most cases an absorption of one fiftieth of the mean value could be detected with reasonable certainty, this characteristic absorption can probably be used with confidence in detecting the presence or absence of these groups in organic molecules. This forms the basis of the method here proposed for detecting some forms of chelation, the absence of such OH absorption in molecules showing OH by ordinary chemical tests being taken as indicating chelation through hydrogen. The variations in the area under the absorption curve constitute one of the quantitative differentiating factors which have been developed in the above mentioned research in an attempt to build an analytical method. Variations occur also within any one group such as OH or NH in the position of the absorption, as well as in the shape of the absorption curve, the latter being particularly striking. In those of the compounds discussed below which show OH absorption, pronounced variations in all three of these factors occur, and they may all be important in the matter of chelation, but their significance requires further study for its interpretation.

Particular examples of compounds that have been examined in the above manner and found to give no absorption characteristic of molecules containing

OH are: salicylaldehyde, *o*-nitrophenol and 2, 6-dinitrophenol, which have properties typical of chelated substances[2]; methyl salicylate and *o*-hydroxyacetophenone which, although not previously tested, are representative of Prof. Sidgwick's Type B[3]; and salicyl-α-methyl-α-phenylhydrazone and γ-diethylaminopropanol. While there has been no prior consideration of the last two compounds as chelated, in each of them the condition of a six membered ring is fulfilled, however, with nitrogen replacing oxygen. Benzoin and 8-hydroxyquinoline, which form chelated salts[4], give characteristic OH absorption, as also do ethyl lactate and diethyl tartrate. These last compounds apparently are doubtful cases of chelation; the first three require five membered rings and in the last one either five or six membered rings are possible.

Characteristic OH absorption was found in *p*-hydroxybenzaldehyde, *m*-nitrophenol, *p*-hydroxyacetophenone, *o*-chlorophenol, and 2, 4, 6-trichlorophenol, which were selected, from the OH compounds that we have examined, as non-chelated compounds comparable to the first five of the above mentioned substances. 2, 4, 6-Trichlorophenol is further of interest in that the OH group is so placed as to be 'sterically' affected in reactions. It is probable, for physico-chemical reasons, that neither these nor the preceding observations have been influenced by association since the solutions are of the order of 0·01 molal.

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[1] *J. Amer. Chem. Soc.*, **55**, 3574; 1933.
[2] *J. Chem. Soc.*, **123**, 2819; 1923.
[3] "The Electronic Theory of Valency" (London, 1929), p. 240.
[4] Ref. 3, p. 245.

Surface-force Theory of Crystal Rectification

EXPERIMENTS with Mr. A. K. Das-Gupta have shown that when carborundum, zincite or silicon crystal is placed between two mercury electrodes giving a large contact area, there is considerable rectification. Similar experiments with symmetrical crystals like iron pyrites, galena, etc., have shown no rectification. These experiments strongly suggest asymmetric conductance in crystals having no centres of symmetry. Accordingly, crystal detectors can be classified thus: (1) crystals having centres of symmetry, and (2) crystals having no such symmetry. In the symmetrical crystals, we observe rectification associated with point contacts. In the second group, in addition to this 'point'-rectification, there is *volume* rectification, due to asymmetric conductance. The object of the present note is to suggest a theory of rectification in the *symmetrical crystals*.

In an ionic crystal (like iron pyrites, galena, etc.), if we take a plane where *similar* sets of ions are placed at regular intervals, it is evident, if we consider the first layer and the next, that any ion on the surface has an unbalanced electrostatic force. When an alternating voltage is applied to the surface of a crystal where crystal planes parallel to the surface contain similar sets of ions, this electrostatic force on the surface would give rise to a unidirectional current. The crystal plane in the first layer may contain *all* positive or *all* negative ions. Both positive and negative rectification effects are therefore possible. In planes which contain oppositely charged ions *alternately*, the 'whisker' is in contact with a large number of such ions, thus giving, on an average, no rectification. This is what is actually observed in natural poly-crystals.

Of the two features in the current-voltage characteristic curves, namely, (1) asymmetry and (2) curvature, the first is explained in the symmetrical crystals in terms of the electrostatic force on the surface; the second is due to:

(1) local heating at the junction, as pointed out by Eccles[1], and

(2) the effect of strain on the crystal, as explained by Dowsett[2].

A small contact area for the 'point' rectification is necessary, because a large contact area means a large number of small contact points of varying degrees of rectification giving on the average a small effect. Besides, for some points, the contact resistance is extremely small, causing more or less a short circuit.

The surface-force theory can explain the following experimental results obtained in this laboratory:

(1) Rectification observed in the case of symmetrical crystals in contact with pointed crystals of the same composition. (Eccles's thermo-electric theory[3], and Schottky's electronic theory[4], fail to explain these results.)

(2) Decrease of rectification on heating the crystal.

(3) Decrease of rectification on heating the junction in the case of symmetrical crystals.

(4) Decrease of rectification on exposure to ultra-violet light and X-rays.

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Nov. 5.

[1] Eccles, *Proc. Phys. Soc.*, **22**; 1914.
[2] Dowsett, "Year Book of Wireless Telegraphy, 1922". (See also Dowsett's "Wireless Telephony and Broadcasting", Vol. 2, Ch. ii.
[3] Eccles, *Proc. Phys. Soc.*, **25**; 1915.
[4] Schottky, *Z. Phys.*, **4**; 1923.

Synthesis of Vitamin C by Luteal Tissue

MOURIQUAND and Schoen have shown[1] that gravid female guinea pigs on a scorbutic diet develop scurvy only very slightly or not at all. They considered that the fœtus was capable of synthesising vitamin C, and thus protected the mother from incurring the disease. Afterwards, Rohmer, Sanders and Bezssonoff[2] and Rohmer, Bezssonoff and Stoerr[3] showed that the young human infant, up to the age of five months, is capable of synthesising vitamin C.

It appears from these results, therefore, that the fœtus almost certainly synthesises vitamin C in fairly large amounts. It is known that the corpus luteum possesses a high concentration of the vitamin in its cells, and the question arises whether presence of the vitamin in this situation is the result of its manufacture by the fœtus, or whether it is the result of the intake of vitamin C in the food.

It was decided to endeavour to create a corpus luteum in an experimental animal with the aid of the luteinising hormone of the anterior pituitary, in order to ascertain whether this would protect the animal from scurvy induced by a scorbutic diet.

The chief difficulty was in the choice of animal.

Rats, mice and rabbits are the most suitable animals on which to use the luteinising hormone, but they possess the ability to synthesise vitamin C to varying degrees. The guinea pig, while being an admirable subject for tests in connexion with scurvy, does not readily respond to the luteinising hormone. It was found, however, that in guinea pigs, injections of fifty rat units of antuitrin S for three days, while it did not produce a definite corpus luteum, caused considerable luteinisation of groups of cells. These cells also possessed the power of reducing silver nitrate.

Three groups of animals were then placed on a scorbutic diet: (*a*) pregnant females; (*b*) young virgin females, untreated; (*c*) young virgin females receiving fifty rat units of antuitrin S a day subcutaneously (50 rat units = 0·5 c.c. antuitrin S). The diet consisted of bran and pollen, olive oil, wheat germ, Radiostoleum, common salts. All the animals lost weight on this diet. At the end of a fortnight, all the untreated animals had died of typical scurvy—their adrenals giving no reaction with vitamin C.

The treated animals, although having lost considerable weight, were active and showed no signs of scurvy, although two had died of an acute infection. The pregnant animals appeared much the same as when the experiment started and had lost very little weight.

The results of this experiment suggest that the luteal tissue is capable of synthesising vitamin C; it does not disprove the synthesis of vitamin C by the fœtus. It is probable that the synthesis takes place first in the corpus luteum and, once the fœtus is developed, it either takes over, or supplements, the vitaminogenic function of the luteal tissue.

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Nov. 16.

[1] G. Mouriquand and J. Schoen, *C. R. Soc. Biol.*, **187**, 203; 1933.
[2] P. Rohmer, U. Sanders, and N. Bezssonoff, NATURE, **134**, 142, July 28, 1934.
[3] P. Rohmer, N. Bezssonoff, and E. Stoerr, *Bull de l'Acad. de Med.*, 871, June 1934.

Activation of Cambial Growth

EVIDENCE was recently obtained by one of us[1] indicating that the influence coming down from the leaves, which activates cambial growth, is a hormone. Also Laibach[2] has caused decapitated epicotyls of *Vicia Faba* and various leaf-stalks to grow in thickness by placing on them the pollinia of orchids, which he has shown to exude large quantities of auxin, the hormone which promotes the elongation of stems; but he has not stated what anatomical changes were involved. We have now been able to activate cambial growth in decapitated strips of young sunflower hypocotyls, by inserting the upper ends of the strips into a 0·02 per cent solution, in 25 per cent gelatine, of the ether-soluble component of urine, which is known to contain abundant auxin[3]. The gelatine containing the extract was applied in short pieces of glass tube while warm and liquid, and quickly set to a gel. It contained a little thymol (1 in 100,000), and was renewed every three days.

After 19 days, the parts covered by the gelatine had all formed cambia, which were in the normal positions and had grown very strongly, one of them having formed more than twelve layers of secondary xylem. These parts had also, quite unexpectedly, formed numerous roots. A few millimetres below the gelatine, also, there had been distinct cambial growth, though at this level it was very much less. In controls, gelatine and thymol without the extract did not cause any cambium or roots to be formed. The results raise the question whether, in spite of some indications to the contrary[1,4], the hormone activating cambial growth is the same as auxin. The experiments will be continued.

We are much indebted to Dr. Weisberger, of the organic chemistry laboratory, Oxford, for kindly showing us how to extract the ether-soluble component by the method of Kögl and collaborators[3].

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[1] Snow, R., *New Phyt.*, **32**, 288; 1933.
[2] Laibach, F., *Ber. Deutsch. bot. Ges.*, **51**, 336; 1933.
[3] Kögl, F., Haagen-Smit, A. J., and Erxleben, H., *Z. physiol. Chem.*, **214**, 241; 1933.
[4] Snow, R., *New Phyt.*, **31**, 351; 1932.

Recession of the Spiral Nebulæ

THE very recent and inspiring work of Prof. E. A. Milne on world structure has led us to investigate whether there exists a law connecting the velocity and distance of a particle from an observer which is invariant for the generalised Lorentz transformation. In the usual notation, the only law of the form $f(x_1, x_2, x_3, x_4) = 0$ which is invariant for the infinitesimal Lorentz transformation is known to be $x_1^2 + x^2 + x_3^2 + x_4^2 = 0$, which gives the propagation of light. Following this, we have investigated whether there exists a law of the form $\varphi(x_1, x_2, x_3, x_4, u, v, w) = 0$ which is invariant for the generalised Lorentz transformation; here $u = dx_1/dx_4$, $v = dx_2/dx_4$, etc. In its generalised form the transformation is

$$\begin{aligned} x_1' &= x_1 + (hx_1 + ax_2 + bx_3 + cx_4) \\ x_2' &= x_2 + (-ax_1 + hx_2 + dx_3 + ex_4) \\ x_3' &= x_3 + (-bx_1 - dx_2 + hx_3 + fx_4) \\ x_4' &= x_4 + (-cx_1 - ex_2 - fx_3 + hx_4), \end{aligned}$$

$$\text{and} \quad u' = \frac{u + (hu + av + bw + c)}{1 + (h - cu - ev - fw)};$$

similarly, v', w' may be obtained. $h, a, b \ldots$ are the constants of the transformation. We have found that the following set of equations is the only invariant set of this type, that is, involving both velocities and co-ordinates:

$$\frac{u}{x_1} = \frac{v}{x_2} = \frac{w}{x_3} = \frac{1}{x_4} \quad \ldots \quad (1)$$

The corresponding equations for $u', v', x_1', \ldots$ follow immediately from (1).

The importance of (1) may be judged from the fact that, next to the equation of light, the most fundamental relation hinged upon the Lorentz transformation is the distance-velocity relation (1), which has been expressed by Milne in the form $v = r/t$.

It is natural to expect that a relation of this nature should hold good only in the outer regions of space where the island universes are too far

removed from each other to cause any appreciable departure from this law. It is, at any rate, unreasonable to expect the law to hold good in the central galaxy itself because of the powerful gravitational field in it.

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Dec. 17.

THE recession-law, $v = r/t$ in combination with the density-distribution law $ndxdydz = Btdxdydz/(t^2 - r^2/c^2)^2$, can be shown to be a valid description of a certain system of particles in motion on *any* relativistic law of gravitation. This was the subject of my lecture to the London Mathematical Society, "World-Gravitation by Kinematic Methods", delivered on May 17 last (see NATURE, May 26, 1934, p. 789). A full discussion of this subject is given by me in a volume now passing through the press.

E. A. MILNE.

Rotational Raman Effect in Gases: Carbon Dioxide and Nitrous Oxide

IN the course of a detailed investigation of the rotational Raman effect in gases, we have obtained the following significant results with carbon dioxide and nitrous oxide. In Fig. 1 are shown photomicrometric records of the rotational wings obtained with carbon dioxide gas at pressures of about 6 and 50 atmospheres respectively. The exposure times are so adjusted that the intensity of the wing is nearly the same in both cases. It may be noticed that in the low pressure record, the wing exhibits distinctly a position of maximum intensity, shown by the arrow, and then fades off until it merges into the Rayleigh line.

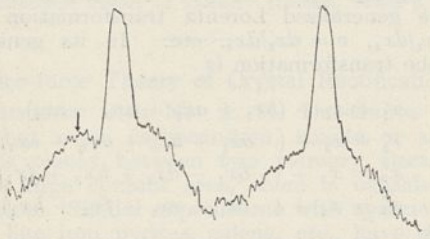

FIG. 1. Photomicrometric records of the rotational wings with carbon dioxide at pressures of 6 atmospheres (left) and 50 atmospheres (right).

A quantitative investigation reveals that both the position of the intensity maximum and the distribution of intensity within the wing are in good agreement with theory. On the other hand, in the high pressure record, no such maximum is visible and the wing is relatively more intense in the region lying between the position of the maximum and the Rayleigh line. It is of significance that these features which are characteristic of liquids[1] make their appearance also in gaseous carbon dioxide, but only at the higher pressure. Exactly similar results are obtained by us with nitrous oxide working at 6 and 40 atmospheres respectively. Such phenomena are evidently connected with the fact that, at the higher pressures, the gases investigated are very near their critical states, thus resembling the liquids in certain respects.

It may be of interest to note here that our measurements of the intensity maxima at low pressures give 69×10^{-40} and 62×10^{-40} respectively for the moments of inertia of CO_2 and N_2O molecules, as against $70{\cdot}1 \times 10^{-40}$ and $59{\cdot}4 \times 10^{-40}$ deduced earlier from infra-red absorption[2].

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Physics Department,
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Waltair.
Nov. 8.

[1] *Ind. J. Phys.*, **8**, 437; 1934.
[2] Adel and Dennison, *Phys. Rev.*, **44**, 99; 1933. Plyler and Barker, *Phys. Rev.*, **38**, 1827; 1931.

Development of the Lightning Discharge

SOME months ago, B. F. J. Schonland and H. Collens[1] published several important photographs of lightning discharges taken by a Boys' camera, that is, two lenses fixed at opposite points of a circle and revolving rapidly about its centre. In a further communication, with D. F. Malan, published in NATURE[2], a brief account is given of some further results with their camera. The most important point which emerges from a consideration of their new photographs is that there is a characteristic difference between the predischarges of the first stroke of a lightning flash and those of the subsequent strokes of the flash along the same track. While the latter predischarges are of a continuously moving character and travel from cloud to ground generally in less than 1/1,000 of a second, the former move from the cloud in a discontinuous step by step manner and take a comparatively long time to reach the ground, sometimes more than 1/100 of a second.

I would remark here that this manner of the first development of the track of an electric discharge through normal air was shown by me for the laboratory spark so long ago as 1898[3] and for the lightning discharge in 1902[4], in both cases using moving photographic plates to analyse the discharges.

B. WALTER.

Physikalisches Staatsinstitut,
Hamburg.

[1] *Proc. Roy. Soc.*, A, **143**, 654; 1934.
[2] NATURE, **134**, 177, Aug. 4, 1934.
[3] *Ann. Phys. und Chem.*, **66**, 636; 1898. **68**, 776; 1899.
[4] *Ann. Phys.*, **10**, 393; 1903. A more detailed account appeared in *Jahrbuch d. Hamburg. wiss. Anstalten*, **20**; 1903.

Moulting and Replacement of Feathers

IN a recent publication, Dr. Lowe[1] has described the peculiar moulting of penguins as due to new feathers pushing out their predecessors in rather widespread areas, and regards this as a unique feature of Sphenisciformes. Moulting in patches is certainly a rare occurrence under normal conditions in the majority of birds, but a new feather growing at the base of the old feather is the usual method of replacement during the moulting period. Dr. Lowe further says: "the intrusion of the tip of the new feather through the lower umbilicus of the old is interesting, because in birds in general as soon as the growth of the feather becomes an accomplished fact the lower umbilicus at the base of the calamus is definitely sealed, making the entry of a new feather an impossibility". He continues by using this as one of the reasons for regarding the penguin as primitive rather than degenerate, and quotes Gadow that the

only known exception to this general rule is in *Struthiones*, where the old feather is carried for some time at the tip of the new.

Although statements have recently been made (Lillie and Juhn[2]) saying that it is not yet known whether the pulp of a feather resumes activity prior to shedding of the old feather, it is a well-known fact (Lynds Jones[3], Cossar Ewart[4] and others) that in young chicks and ducklings, the first generation feather is carried for some time at the tip of the succeeding definitive feather. Again, in adult fowls and ducks, if feathers are plucked near the moulting period, the new feather is invariably pulled away attached to its predecessor. This is unavoidable owing to the method of formation of the new feather. In nestling down, there is definite continuity between barbs of the new feather and the calamus of the old one, and in addition, the developing barbs are so constricted within the calamus of the old feather, that they usually show a distinct curve distally for some time after the old feather has been shed.

In definitive feathers, the new feather is always formed within the base of the old (except, of course, during regeneration following deliberate plucking). This is due (*a*) to the outermost intermediate cells of the 'collar' cornifying to form the base of the calamus, instead of the whole of the stratum intermedium cornifying *en masse*, as it does more distally, while (*b*) the median layers form a second sheath within the calamus, and (*c*) the innermost layers form the ridges from which the barbs of the new feather arise. This process is described in detail in a paper now in press.

From this method of replacement of a feather, the lower umbilicus could not be completely sealed when the feather is fully grown. It is true that feather caps form as the pulp withdraws when the feather is nearing maturity, but these do not extend to the actual base. A minute papilla projects within the inferior umbilicus while the feather is attached to the bird, limited in its extension by the last feather cap, and it is from this papilla that the new feather grows. If the old feather is plucked when fully mature, but before the new feather has commenced to form, then this remnant of the previously extensive pulp is left behind in the follicle, so that the impression of an entirely pulpless and sealed feather is obtained.

It is therefore clear that these facts of the inferior umbilicus of the feather remaining unsealed, and the new feather pushing out the old, cannot be regarded as peculiar to Sphenisciformes or to Struthioniformes.

Zoology Department, University, Leeds. Dec. 5. ANNE HOSKER.

[1] *Proc. Zool. Soc.*, 483–538; 1933.
[2] *Phys. Zool.*, V., 124–184; 1932.
[3] *Lab. Bull.*, No. 13, Oberlin College; 1907.
[4] *Proc. Zool. Soc.*, 609–642; 1921.

Occurrence of *Limnocnida* in the Periyar Lake, Travancore

ON June 4 last, I was surprised to find a number of fresh-water medusæ in the Periyar Lake in Travancore. From the shape of the manubrium and the presence of the gonads on the manubrium, and the shape and the arrangement of the nematocysts, the medusæ undoubtedly belong to the genus *Limnocnida* which has previously been recorded from India. The Periyar Lake, about ten square miles in extent, has been formed by damming at its source in the Western Ghats the River Periyar, which flows westwards. Although the river fluctuates with the seasons, the lake contains deep water all the year round. It is noteworthy that fresh-water medusæ were found by Mr. S. P. Agharkar, but were in a river system which flows eastwards across the continent and enters the Bay of Bengal.

The Periyar Lake is situated at an elevation of three to four thousand feet and is sixty miles from the west coast of India as the crow flies. All the medusæ I saw were about the same size and very much smaller than those discovered by Mr. Agharkar. Mr. Agharkar's specimens measured 1·75 mm. when young, 15 mm. when adult. The smallest of my specimens, however, measures 4·2 mm. in diameter and the largest 4·9 mm. in diameter and 2·2 mm. in height, with tentacles measuring 1·6 mm. So far, they have received only a cursory examination.

I believe the occurrence of *Limnocnida* has only been recorded from one area in India previously, that is, in the headwaters of the Kistna River and the neighbourhood, 650 miles from Periyar. Whether the species inhabiting the Periyar Lake is the same as that described by Dr. Annandale or a new species can only be determined after a proper examination of the collection.

PHYLLIS SEYMOUR DARLING.
Claybrooke, Kilpauk, Madras. Dec. 13.

Local Variation in Habits of the Lizard, *Amblyrhyncus cristatus*

ON a recent visit to the Galapagos Archipelago I noticed a point concerning *Amblyrhyncus cristatus*, an aquatic species, which might be of interest as a footnote to Darwin's observations on the same reptile.

In "The Voyage of the *Beagle*", Darwin says: "I several times caught this same lizard, by driving it down to a point, and though possessed of such perfect powers of diving and swimming, nothing would induce it to enter the water; and as often as I threw it in, it returned in the manner above described".

I tried this same experiment myself on Albemarle Island, and found the reptile returned to dry land at great speed, but on Indefatigable Island, on the contrary, the lizards not only held no prejudice against entering the water, but even proceeded to do so as quickly as possible on being approached—a curious example of local variation.

Darwin attributes their reluctance to enter the water to the presence of sharks, but it is singular that I found sharks more numerous around Indefatigable Island than elsewhere in this archipelago.

J. G. WYATT TILBY.
5, Princes Court, Hampstead, N.W.3. Dec. 26.

Simultaneous Travel of a Surge of Stress and a Group of High-Frequency Waves of Stress in a Steel Wire

IN previous communications, it has been shown how the frequency of longitudinal vibration of a steel wire may be measured[1] and also how the speed of travel of a surge of stress in a steel wire may be measured directly[2]. From each of these methods the value of Young's modulus may be found, and the

values so obtained are in close agreement with each other and with the value obtained by the static method.

Experiments have recently been made in which a surge of stress and a group of high-frequency waves of stress were caused to travel simultaneously along a steel wire. For this purpose, a hard drawn steel wire as used in colliery winding ropes was obtained of a total length of about 500 ft. and diameter 0·123 in. The wire was firmly clamped near one end by means of three clamps spaced about 18 in. apart. About 50 ft. from this end the wire passed through a solenoid and search coil, and a second exactly similar solenoid and search coil was arranged at a distance of 268·3 ft. along the wire from the first solenoid, the free length of wire beyond the second solenoid being 185·7 ft. The solenoids were connected in series and excited by direct current. The two search coils could be connected in series through a valve amplifier to the oscillograph or each coil could be used alone when so desired. A 500 frequency standard tuning fork was used to provide the timing wave.

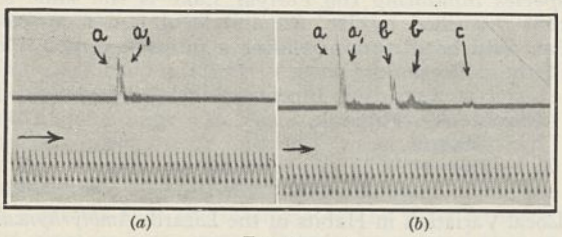

FIG. 1.

In the first test, the search coil of No. 1 solenoid was used alone. When the wire was struck at the clamped end the oscillogram shown in Fig. 1*a* was obtained. It will be seen that a group of high-frequency waves is superposed at a_1 on the surge *a*, this group being due to the longitudinal vibration of the clamped sections of the wire. There are also smaller groups of waves which pass through the solenoid later, but after about 0·016 sec. no further disturbances pass. In Fig. 1*b* is shown the oscillogram which was obtained when the two search coils were connected in series and a blow was struck at the clamped end of the wire. It is now seen that the group of high-frequency waves again appear at a_1 superposed on the surge at *a*. When, however, the disturbance has reached the second search coil, the surge and the group of waves have become widely separated as shown at *b b*, so that the group is travelling at a much lower speed than the surge. The peaks at *c* are due to the reflexion of the surge at the distant end of the wire returning through the second solenoid.

It is not clear why the group of waves should travel at a speed so much slower than the surge. Experiments with an annealed wire indicate that the speed of the group is more nearly equal to that of the surge. Further experiments are being made to observe the effects on this phenomenon of the frequency of the waves in the group.

T. F. WALL.

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University,
Sheffield.
Nov. 30.

[1] NATURE, **132**, 351; 1933.
[2] NATURE, **133**, 418; 1934.

Accuracy of the Curie-Chéneveau Magnetic Balance

IN a letter to NATURE[1] and also in a recent Royal Society paper[2], F. E. Hoare mentions difficulties that he has had with the Curie-Chéneveau magnetic balance and states that after a trial of some months he has decided to abandon the use of this instrument. He concludes that it is "almost impossible" to place the specimen always in exactly the same position in the field and he thinks that he can thus explain "the unaccountable changes in the deflexion for water obtained from time to time" by Gray and Dakers[3] and described by them in the words just quoted. These unaccountable variations, however, are in many cases observed even when the tube has not been removed from the beam between readings, and in any event do not exceed 1 per cent, whether the question of position is involved or not. Instead of the 20 per cent of Hoare, the variations observed in this Department are thus of a much smaller order, even with the balance in its crudest form, and probably are due to a different cause. The instrument is free even from this small irregularity in its normal working condition. Both the steadiness attainable and the ease with which the position can be adjusted, with reasonable care, are indicated by the latest measurement made in this department by one of us (J. H. C.).

Deflexions were read for four separate fillings with water and four separate fillings with ethyl nitrate. It was impossible to detect the slightest difference between the four water readings: each was 16·00 ± 0·01 cm. for tube + water. Similarly, the four readings for tube + ethyl nitrate were identical, namely, 12·30 ± 0·01 cm., in every case, with not the slightest variation. The eight measurements were done in 2½ hours.

Hoare directs attention to the discrepancies between the results of Gray and Dakers[3] for rubidium bromide and those of Ikenmeyer[4], although from his recent paper[2], when he compares his own results with those of Ikenmeyer, he has a rather poor opinion of the latter as standards for comparison. Gray and Dakers' results are supported, however, by Pascal[5], the sum of whose atomic values, 57·8, is much closer to the 56·69 ± 0·54 of Gray and Dakers[3] than to the 65·5 of Ikenmeyer (quoted by Hoare) or to the 62·9 of N. Crow[6]. Pascal adopted non-torsional methods, and to compute his atomic values utilised at least nine substances.

The usefulness of this instrument, however, does not depend upon a few isolated instances. Numerous results of high precision have been obtained, and confidence in these results is further strengthened by the adaptability of the data to interpretation. There must be reserved for a future communication a fuller account of results achieved with the balance and also a description of improvements in the apparatus and in the details of its manipulation. It is hoped, in this way, to put our experience at the disposal of those prepared to give the instrument a trial.

FRANCIS W. GRAY.
JAMES H. CRUICKSHANK.

Department of Chemistry,
University, Aberdeen.
Dec. 13.

[1] F. E. Hoare, NATURE, **132**, 514; 1933.
[2] F. E. Hoare, *Proc. Roy. Soc.*, A, **147**, 88; 1934.
[3] Gray and Dakers, *Phil. Mag.*, **11**, 81; 1931.
[4] Ikenmeyer, *Ann. Phys.*, **1**, 169; 1929.
[5] P. Pascal, *C.R.*, **158**, 37; 1914.
[6] N. Crow, *Trans. Roy. Soc. Canada*, **19**, 63; 1925. NATURE, **117**, 449; 1926.

Disintegration by Slow Neutrons

CHADWICK and Goldhaber, in their letter to NATURE on January 12, record experiments which indicate that slow neutrons can eject heavy charged particles from light atoms, even when the neutron traverses the atom "at relatively large distances" from the nucleus. To account for this, they suggest that there may be an attractive force between a nucleus and a neutron, at these large distances.

An alternative explanation is that the heavy particles are not in the nucleus, but outside it.

JOHN TUTIN.

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Jan. 14.

Velocity of Sound in Liquid Oxygen

IT seems that the velocity of sound has never been measured in liquefied gases at low temperatures, probably because the customary methods were not easily practicable. It appeared reasonable to try as a new method the effect, which has recently been discovered by Debye-Sears and Lucas-Biquard, namely, the scattering of light by ultrasonic waves in liquids and solids. Judging from the results which I have obtained using oxygen as a scattering liquid, this method provides indeed a simple and convenient means for this purpose. The experiments, which were carried out with oxygen of 99·3 per cent purity, boiling at atmospheric pressure (705–720 mm. mercury) at $-183{\cdot}6^{\circ}$ C., and with a frequency of 7,500 kilocycles, yielded a sound velocity of 903 m./sec. Taking 1·140 as the density of the liquid, one gets then an adiabatic compressibility of $105{\cdot}6 \times 10^{-6}$ cm.^{2}/kgm. The isothermal compressibility may also be calculated; with $3{\cdot}38 \times 10^{-3}$ as the value of the differential of the specific volume, and 0·406 as the specific heat at constant pressure, it comes out as $172{\cdot}0 \times 10^{-6}$ cm.^{2}/kgm.

A detailed account will appear in *Helv. Phys. Acta*.

R. BÄR.

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Zürich.
Dec. 27.

Points from Foregoing Letters

BY means of a powerful source of neutrons (half a gram of radium mixed with beryllium) Prof. J. C. McLennan, Mr. L. G. Grimmett and Mr. J. Read have produced measurable radioactivity in the elements molybdenum, palladium, tantalum, tungsten and platinum. They have determined with fair accuracy the radioactive life-periods thus induced in these elements.

The amount of absorption of infra-red light (1·4–1·6μ) by certain organic substances can be related to their molecular structure as deduced from chemical tests, solubility, volatility, etc. Dr. Hilbert and Messrs. Wulf, Hendricks and Liddel state that when a hydrogen atom of an organic molecule is joined to two oxygen atoms by a co-ordinate link (that is, it forms a 'chelate' ring by sharing two electrons of one of the oxygens) then the compound does not show the usual amount of infra-red absorption typical of ordinary compounds containing the OH group, although by chemical tests the OH group appears to be present.

Crystals without a centre of symmetry (carborundum, zincite) when placed between two mercury electrodes, can be used as radio-detectors, while symmetrical crystals (galena, pyrites) do not give rectification with such large contact areas, but only with point contacts (cat's-whisker). Dr. S. R. Khastgir outlines a theory based upon the arrangement and the unbalanced electrostatic forces of the atoms in the surface layers of the crystals, and claims that this theory explains a number of observations not accounted for by other views of crystal rectification.

It has been shown that infants can produce their own vitamin C. From experiments with female guinea pigs in which luteal tissue was artificially induced, Dr. Geoffrey Bourne deduces that the corpus luteum of the ovary also has the ability to synthesise the anti-scorbutic vitamin C.

Mr. R. Snow and Mr. B. Le Fanu find that the cambium cells from strips of decapitated young sunflower plants, not only continue to grow, but even produce wood cells (xylem) and give off roots, when covered with gelatin containing auxin (from the ether-soluble extract of urine). This raises the question whether the hormone activating cambial growth may not be identical with auxin, which has been shown to promote cell elongation and root formation

Prof. V. V. Narlikar gives an equation, which he states to be the only one, relating space-time *and velocity* in such a way that the formula is invariant (independent of the observer's motion). From this formula the recession of spiral nebulæ can be deduced.

The distribution of intensity in the spectrum of the light scattered by gases at different pressures has been determined by Mr. S. Bhagavantam and Mr. A. V. Rao. They find that the 'wings' of continuous light, which appear at the sides of the primary line and have been ascribed to the rotation of molecules, become similar to those obtained with liquids, when the gases are under high pressure.

The replacement of feathers in fowls is described by Miss Anne Hosker, who points out that not only in penguins and ostriches, as mentioned by Dr. Lowe, but also with young chicken and ducklings, the first feathers during moulting are carried for some time at the tips of succeeding ones.

Dr. T. F. Wall reports that in a hard-drawn steel wire, with one end clamped by three clamps 18 in. apart, a group of high-frequency waves of stress (produced by a blow at the clamped end) was found to travel along the wire more slowly than the simultaneous surge of stress. In an annealed wire, the speed of the group of waves is more nearly equal to that of the surge.

Dr. F. W. Gray and Mr. J. H. Cruickshank defend the accuracy of the Curie-Chéneveau magnetic torsion balance; they do not agree with F. E Hoare that the unexplained variations observed at times by Gray and Dakers with water are due to the unreliability of the balance.

Research Items

Origins of Morris Dance. The question of the origins of the Morris dance and of its name is once more raised by Mr. Rodney Gallop (*J. English Folk-dance and Song Soc.*, **1**, No. 3). The belief generally held that 'Morris' was a corruption of 'Morisco' and the dance itself of Moorish origin was doubted so long ago as the time of Strutt, who in his "Sports and Pastimes of the People of England" suggested that it was derived from a part of the ceremony of the Feast of Fools; but Francis Douce in 1839 tried to justify the traditional view, while recognising that the European Morris differed widely from the true Moorish dances. Cecil Sharp at first (1906) adopted Douce's view, but later (1912) held that it was a development of a pan-European, or even more widely, distributed custom. He held, however, that the name might still be derived from 'Morisco', but without any implication of origin. It was a popular 'explanation' of the blackened faces of the dancers. It is now pointed out that 'Morisco' is applied to a wide diversity of dances, first appearing in the fifteenth century in France, Burgundy and Italy. In England, from the sixteenth century onward, it is both a court dance and a folk-dance. No single feature is common to all, the two widespread elements, the blackening of the face and the use of bells, to which attention mainly has been directed, being by no means universal. In numerous ceremonial combats, the opponents are 'Christians' and 'Moors'. These combats were of wide distribution and still survive in Portugal and on the east side of the Adriatic, and they have been carried to Panama and Mexico. The Morisco of the Hispanic peninsula does not always involve two sides and a combat. Some are purely processional, though in origin obviously a survival of the pagan ceremonial combat. One side has tended to disappear, and the survivors have retained the name of 'Moor', possibly as the equivalent of 'pagan' and as applied to a 'pagan' dance.

New Fishes from New Jersey and Florida. Mr. Henry W. Fowler in his paper "The Buckler Dory and Descriptions of three New Fishes from off New Jersey and Florida" (*Proc. Acad. Nat. Sci. Philadelphia*, **86**; 1934) describes an interesting new species of *Macrorhamphosus*, *M. otteri* which has before been confused with the Mediterranean *M. scolopax*, but differs from it in the more advanced spinous dorsal origin and consequently longer interdorsal area, and in its deeper body. *Parathunnus rosengarteni* n.sp. is also described from a mounted specimen angled by Dr. Rosengarten in Florida waters, and recognised by him as a species distinct from any with which he was acquainted. This fish has a lateral golden band running along the whole length from eye to tail and measures 713 mm. Another interesting new species is *Antigonia browni*, the depth of which is 1/5 greater than its length; it differs in many ways from its Barbados relative *Antigonia capros*, Lowe, the only other American species known. The specimens of the Buckler dory, *Zenopsis conchifer*, establish its distribution over the western Atlantic, known from there previously only from the imperfect and immature *Zeus ocellata*, and indicate that it is likely to occur all along the region of the Gulf Stream.

Culture of the Mantle-Wall of *Helix*. J. Brontë Gatenby, Joyce C. Hill and T. J. Macdougald (*Quart. J. Micro. Sci.*, **77**, Pt. 1, 1934) give an account of the technique of the culture of small pieces of the mantle-wall of *Helix aspersa*, more particularly to obtain aseptic growths. In such cultures the amœbocytes wander out of the piece of tissue and become much flattened, but do not form a connective tissue network to such a degree as in non-aseptic culture. In older explants, the Golgi apparatus of the amœbocytes breaks up into granules which become scattered through the cells; hence statements concerning the Golgi apparatus, based on evidence obtained from cells in culture, are of doubtful value. There is good evidence that the cells in the tissue cultures of *Helix* divide by amitosis. The amœbocytes do not ingest bacteria until the latter have become very numerous. Joyce C. Hill contributes (*J. Roy. Micro. Soc.*, **54**, No. 3, 1934) a useful article on the technique of the culture of the tissue of *Helix*. The Hédon-Fleig saline solution, the composition of which is stated, proved to be the most satisfactory, for in this the amœbocytes which emigrated from the mantle wall produced a well-organised connective tissue network. By sterilising pieces of tissue, either by exposure to ultra-violet radiation or by soaking in blood, the life of the cultures was much prolonged. The amœbocytes were more flattened and did not unite to form a definite network.

Iodised Wraps for Fruit Storage. Mr. R. G. Tomkins, of the Low Temperature Research Station, Cambridge, has investigated the possibilities of using iodised coverings for fruit when placed in storage. The severity of many fungal diseases of storage is notorious, and the use of germicidal covers would appear to be one of the most obvious methods of control, if the fungicide has no harmful effect on the fruit. Initial difficulties seem to have been largely overcome (*J. Pomol. and Hort. Sci.*, **12**, No. 4, pp. 311–320, December, 1934). The iodised wraps are made by treating tissue paper with a definite volume of iodine solution—a covering 25 cm. square contains approximately 30 mgm. of free iodine. Laboratory tests show that storage rots of fruit can be considerably reduced by this kind of wrapping, whilst the appearance and ripening of most varieties is not impaired. Problems for the future include a study of the amounts of iodine absorbed by the fruit, and a more extensive determination of varieties which are harmed by iodine treatment.

Cyclones in Mauritius. The cyclone season of 1932–33 in Mauritius and in the neighbouring parts of the South Indian Ocean is described by N. R. McCurdy, director of the Royal Alfred Observatory, Mauritius, in Miscellaneous Publication No. 15 of that observatory. This is the sixth of a series of publications dealing exclusively with the cyclone seasons of that region. For this year the amount of data available for drawing synoptic charts is greater than at any time previously. There were six cyclones in this season, a smaller number than usual, and fortunately only one of these appears to have been intense. The storm in question appeared on the synoptic charts for March 3–15, 1933, and passed between Mauritius and Madagascar; it followed a very

unusual course, twice approaching Madagascar from the north-east and recurving to the south-east. Several ships were involved in the region around the centre, where winds of hurricane force were encountered with very heavy rain and extremely high seas, and one ship was unfortunate enough to spend some days near the centre, having waited for the storm to pass away to the south-east after the first recurve and being involved in the second recurve, when the rate of travel of the centre was only two miles an hour. Another interesting phenomenon was noted in connexion with two storms in February 1933. These formed within a few days of one another and both appeared on the synoptic charts for several successive days. This is regarded as a common occurrence in this region, for three similar cases were described in Miscellaneous Publication No. 14, which describes the cyclone season of 1931–32. One of the remaining cyclones provides an example of the partial break up of a storm on its encountering the high ground in Madagascar. The author of these papers concludes that cyclones do not disturb the winds of the cirrus level at Mauritius when their centres are more than two or three hundred miles away.

Heating of Electric Cables exposed to the Sun. The maximum current an electric cable can carry is fixed by the temperature rise of the cable after the current has been flowing so long that the cable has attained a constant temperature. It is usual to specify a temperature rise of 50° C. above that of the surrounding air. If the cable is exposed to direct sunlight a substantial increase of temperature will occur, and this will increase the resistance of the cable and consequently the electric power lost in it. The British Electrical Research Association has prepared a report on this subject (*J. Inst. Elec. Eng.*, Dec. 1934). The maximum solar radiation in different parts of the world is known approximately, and useful tabular information is given in this report. From this, the temperature rise of a cable of given diameter suspended on a rack can be determined for a given air velocity by means of a factor which varies with the diameter of the cable and with the velocity of the air. Practical tests were carried out at London, Milan and Buenos Aires. The maximum temperature was observed and is reached when the sky is clear in about half an hour if the cable is exposed to the sun's radiation between 12 noon and 2 p.m. summer time. Under these conditions, cables of about two inches in diameter may show a temperature rise of 17° C. This figure must be deducted from the permissible rise of 50° C. above shade temperature. This materially reduces the permissible current the cable can carry. The results obtained abroad are in good agreement with those obtained in England. In an appendix, the theory of the rise of temperature is given. The agreement of the experimental results with theory is much more satisfactory for the lead-covered cables than for the armoured cables.

An Electric Method for Measuring Young's Modulus. It is well known that a definite relationship exists between the stress and the permeability of iron, steel, nickel and cobalt wires. Joule observed in 1847 that a bar of iron changes its length when magnetised, and forty years later Shelford Bidwell carried out a large number of exact researches in this connexion. He measured the changes of length of wires when placed in a magnetic field both when the wire was loaded and when it was unloaded. Dr. T. F. Wall has developed an interesting electromagnetic method for measuring Young's modulus (*J. Inst. Elec. Eng.*, Dec. 1934; see also NATURE, 132, 351; 1933 and 133, 418; 1934). It is based on the fact that, with magnetisable materials, the magnetic permeability changes with strain. When a rod of iron, steel, nickel or certain alloys is placed axially in a solenoid excited by direct current, and the rod is caused to vibrate longitudinally with its natural frequency, the changes of mechanical stress will produce corresponding changes of the magnetic flux in the rod. Hence an electromotive force of the same frequency will be induced in a search coil which embraces the magnetised part of the rod. The frequency of this E.M.F. is measured by means of oscillograms, and from the density of the metal and this frequency the value of Young's modulus can easily be calculated. For the time wave a standard tuning fork was used having a frequency of 500, the vibrations being maintained electrically. The results obtained by experiments on iron rods, mild and hard drawn steel wires and nickel rods are given. They show that satisfactory results are easily obtained.

A Cosmic Ray Meter. A detailed description has been published of a precision recording cosmic ray meter which has been designed by Profs. A. H. Compton and E. O. Wollan, of the University of Chicago, and R. D. Bennett, of the Massachusetts Institute of Technology, for securing continuous records of the variation of cosmic rays at a number of widely separated stations (*Rev. Sci. Inst.*, Dec. 1934). In order to minimise fluctuations, the ionisation sphere has been made of 19 litres capacity, and is filled with very pure argon at 50 atmospheres pressure. It is protected from local radiations by a 17 cm. layer of uniform lead shot, which reduces their effect to about 0·5 per cent of the usual cosmic ray effect. The ionisation voltage is provided by a 650 volt dry battery, and the ionisation current is nearly compensated by that produced in a small chamber within the larger by the beta-rays from an adjustable surface of metallic uranium. The residue current is indicated by a Lindemann electrometer, the shadow of the needle of which is projected by a compound microscope on a moving strip of bromide paper.

Spectra of Giant and Dwarf Stars in the Red. Some interesting luminosity effects, which will serve as very good criteria for distinguishing giants from dwarfs in stars of spectral type *M*, have been discovered by Dr. Y. Öhman through a study of representative stars in the orange and red regions of their spectra (*Astrophys. J.*, 80, 171). The instruments used were the 60-in. reflector at Mount Wilson Observatory, with the Cassegrain spectrograph and 18-in. camera, giving a dispersion of about 180 A. per mm. at 7000 A. He found that three bands of CaH at 6389–6382 A., 6921–6903 A., and 7305–7208 A. occur conspicuously in the dwarf spectra, but are weak or absent in the giants. These bands first appear (in the dwarf spectra) at type *Mo* and become stronger in later subdivisions, whereas in the giants they are faint throughout. In addition, the spectra of the dwarfs appear smoother than those of giants, on account of the presence of much stronger TiO bands in the latter. The author also confirms Miss Burwell's results for the calcium lines 6162 A., 6122 A., and 6102 A., all of which are very strong in the dwarfs, but faint or invisible in giants.

Chemical Technology at the Imperial College of Science, London

ON January 16, at the invitation of the governing body and the rector, a distinguished company visited the Department of Chemical Technology of the Imperial College of Science and Technology, the occasion providing an opportunity for observing the progress achieved during the past quinquennium.

Under the leadership of Prof. W. A. Bone, the Department, which is exclusively of a postgraduate and research character, has continued its policy of pursuing investigations of a fundamental and pioneering character bearing upon what may be termed 'long distance' problems of industry. Such work invariably calls for new experimental methods, and a feature of the various apparatus on view was that much of it has been designed in the Department itself and some is unique.

The maintenance costs of the Department's extensive research work are naturally heavy, but the support which has always been forthcoming from outside firms and institutions bears ample testimony to the high regard in which its activities are held. The chief extramural contributors towards the researches have been the Royal Society (Messel Fund), the Department of Scientific and Industrial Research, the British Iron and Steel Federation, Imperial Chemical Industries Ltd., the Gas Light and Coke Company, the South Metropolitan Gas Company, Messrs. Radiation Ltd., Messrs. Ferranti Ltd., Messrs. Westinghouse Brake and Saxby Signal Co., and Messrs. E. G. Acheson Ltd. Altogether, the cost of the research work now amounts to upwards of £9,500 a year, of which approximately 65 per cent is met by special *ad hoc* extramural subscriptions. Since its inauguration in 1912, contributions from outside sources towards the research equipment and work of the Department have amounted to more than £60,000 (capital equipment = £15,000), above five-sixths of which has come through Prof. Bone.

During the afternoon, Prof. Bone gave an account of the work of the Department. In subsequent speeches Prof. H. E. Armstrong and Mr. H. James Yates, chairman of Radiation Ltd., paid a high tribute to it and stressed its scientific and national importance. Although Prof. Bone will shortly reach the retiring age of sixty-five, they think it would be calamitous if a stringent application of a rule were allowed to interfere with its continuity or with his continued direction of it.

Recent advances in the work of the Department, which is divided into sections devoted to fuel technology (including high-pressure gas reactions), electrochemistry and chemical engineering were demonstrated in the various laboratories, and may be summarised as follows :—

Fuel Technology

Chemistry of Coal. The cost of this work, directed to problems connected with the natural maturing of coal, has been defrayed mainly by grants from the Fuel Research Board. It has resulted in (i) new knowledge bearing upon the origin and development of the main 'coking constituents' of bituminous coals ; (ii) the discovery not only of the essential 'benzenoid' structure of the main coal substance but also the development thereof throughout the lignin-peat-lignite-coal-anthracite series.

Mechanism of Gaseous Combustion. Several investigations have been continued on (i) the combustion of carbonic oxide, (ii) the combustion of hydrocarbons, (iii) flame spectra, etc. New evidence has been forthcoming that carbon monoxide burns in two ways, one involving and the other independent of the intervention of steam ; also that the initial oxidation product of a gaseous hydrocarbon is the corresponding alcohol as postulated in the hydroxylation theory.

High-Pressure Gas Reactions and Explosions. The work upon gaseous explosions with which Drs. D. M. Newitt and D. T. A. Townend have been specially associated has been extended to initial pressures of 1,000 atmospheres, the highest yet attempted. Nitrogen activation in explosions of carbon monoxide - air media has been shown to reach a maximum at *c.* 350 atmospheres, and nearly 6 per cent of nitric oxide to be recoverable from $2CO + 3O_2 + 2N_2$ explosions at 75 atmospheres.

Dr. Newitt has also developed a new line of work on the pressure oxidation of typical hydrocarbons with the view of elucidating the mechanism of the process and of obtaining large yields of intermediate products. A yield of 50 per cent of methyl alcohol has been obtained from methane and 60 per cent of ethyl alcohol from ethane, while toluene has yielded large amounts of benzyl alcohol and benzaldehyde.

The high-pressure field has also been extended by Dr. Townend to the determination of ignition temperatures of paraffin hydrocarbon, etc. — air mixtures, with results of great significance both theoretically and in regard to internal combustion problems. Briefly, it has been discovered that the ignition temperatures are located in two widely separated ranges, one usually above 500° C. for low pressures and the other below 350° C. for high pressures. Transference of an ignition temperature to the lower range occurs abruptly at a definite critical pressure ; this pressure corresponds with the incidence of 'knock' in an engine at a definite compression ratio.

Another centre of interest was an impressive high-pressure apparatus designed by Dr. Newitt for investigations on liquid organic reactions at pressures of 5,000 atmospheres. This work, which has been financed by Imperial Chemical Industries Ltd., and is under the joint supervision of Profs. Bone and Thorpe, has met with such success that new installations are now in course of erection for pressures between 10,000 and 20,000 atmospheres.

Flame Propagation in Gaseous Explosions. This work has consisted mainly of photographic researches, throughout which Mr. R. P. Fraser has collaborated with Prof. Bone and developed the present Fraser high-speed camera of the rotating mirror type whereby detailed records are obtained, capable of measuring flame movements of frequency down to one-millionth of a second. Important new knowledge concerning the influence of compression waves, the phenomena associated with 'spin' in detonation and the influence thereon of magnetic and electric fields has been obtained, with the result that a new conception of detonation has been arrived at and is shortly to be published.

Blast Furnace Reactions. Begun in 1925, under the auspices of the British Iron and Steel Federation, this investigation has also made notable advances, special apparatus having been devised for determining the relative velocities of 'carbon deposition' and 'ore

reduction' reactions at various temperatures and high gas speeds as met with in blast furnace operations. During the past few years the work, which is carried out by Dr. H. L. Saunders, has thrown such important new light on blast furnace reactions that recently the Federation decided to finance and develop parallel investigations upon actual blast furnace plant. With this end in view, a Committee has been formed, with Prof. Bone as chairman, to organise and carry out this programme of work.

ELECTROCHEMISTRY

Gaseous Combustion in Electric Discharges and Electrical Ignition. Inaugurated in 1925 by Asst. Prof. G. I. Finch, these investigations have been continuously prosecuted, and new light thrown on the combustion of hydrogen and carbon monoxide and on the part played by the hydroxyl radical in such circumstances.

In addition to having established the excitation view of electrical ignition, a notable improvement in the design of electrical ignition systems for mobile internal combustion engines has been achieved. Also as an outcome of work on the analysis of discharge phenomena in ignition, a type of high-speed cathode ray oscillograph has been developed which has now been widely adopted in other laboratories.

Electron Diffraction and Heterogeneous Catalysis. It has been established that electrical condition, catalytic activity and structure of surface catalysts are intimately related. Great progress in this field has recently been made possible by the application of the electron diffraction method of structure analysis.

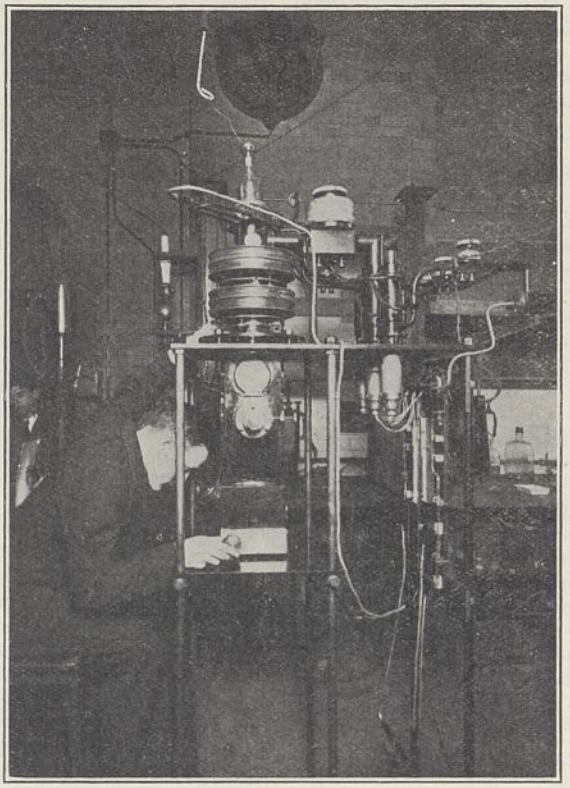

FIG. 1. Electron diffraction camera.

A number of precision cameras designed by Prof. Finch were on view (Fig. 1); other chemical problems being attacked by this new method are: (i) corrosion, (ii) electrodeposition, (iii) thermionic and photo-electric emission, (iv) lubrication, (v) properties of colloidal metals, (vi) formation of surface compounds, etc.

CHEMICAL ENGINEERING

The chemical engineering section of the Department suffered a severe loss through the death of Prof. J. W. Hinchley in 1931. Since that time, Asst. Prof. S. G. M. Ure has taken charge of it and is directing work on general problems such as: (i) heat transmission, (ii) flow of liquids through granular beds, woven materials, etc., (iii) the distribution of energy in ball mill operations, etc.

During the quinquennium, 98 students, 21 of them from overseas, have passed through the Department; of 78 whose locations are known, 63 have passed into industry, 10 into research or business posts and 5 into academic work.

Lunar Influence on the East Anglian Herring Fishery

FLUCTUATION in the yield from year to year, from month to month, and even from day to day, is one of the outstanding and disconcerting characteristics of all herring fisheries. For thirteen seasons, 1921–1933 inclusive, careful records have been kept of the amount of herrings landed daily at Yarmouth and Lowestoft during the late autumn (October-November) fishery off the East Anglian coast. These figures of daily landings have now been submitted to detailed analysis by the scientific staff of the Ministry of Agriculture and Fisheries, Lowestoft, who find that they reveal a definite monthly rhythm in the catches, the maxima coinciding with the period of full moon*.

When the moon is at full in the first week of October its effect is but slight, but the landings gradually increase as the season advances, to culminate in a peak during the week of November full moon. In these circumstances, it is only the middle and later parts of the season which produce good catches. A full moon occurring in the second week of October produces a pronounced peak in the curve of landings, this maximum being followed by one of approximately equal magnitude in the week of November full moon. Full moon in the third week of October produces a still more pronounced peak for this period, but the corresponding November full moon is considerably less effective. Finally, when the moon is at full during the fourth week of October, it produces the largest peak of all, but the late November moon is accompanied by a rise so slight as to be of little benefit to the fishery.

From these observations it follows that the best prospects for a successful fishery—at any rate from the point of view of production—are found when the October full moon occurs in the second week of the month. When this happens, the combined effects of the October and November moons are greatest, and a period of about five weeks good fishing may be

* Lunar Influence on the East Anglian Herring Fishery. By R. E. Savage and W. C. Hodgson. *Journal du Conseil*, **9**, No. 2, 1934; pp. 223–239.

expected. A very late October full moon is the least promising of all, for then only one prominent peak occurs in the fishery. The period of good fishing is therefore very short, and if it should happen that the activities of the fishing fleet be restricted by adverse weather conditions at this time, the chances of a successful fishery in that season are extremely slight.

The occurrence of these peaks in the curves of landings during the weeks of full moon is held to be more than coincidence, and the data certainly appear adequately to support this view. The authors are at a loss, however, to suggest an explanation for this correlation between the yield of the East Anglian herring fishery and a phase of the moon. This task is made all the more difficult by the fact that the same correlation is not exhibited by the herring fisheries in other localities. Either there is no obvious correlation at all between the landings and the moon's phase—as in the Scottish fisheries—or the peaks occur during a different phase of the moon—as at North Shields, where the maxima occur during the 'first quarter'.

It should be emphasised, however, that failure to find an explanation of the influence exerted by the moon on the great East Anglian fishery in no way detracts from the value of the observations which have demonstrated its existence. The authors are therefore to be congratulated upon having fully achieved the two-fold object of their investigations. In a notable advance towards the making of more accurate forecasts of fluctuations in the yield of an important fishery, they have succeeded also in adding materially to the sum of our knowledge concerning lunar periodicity in the behaviour of animals.

G. A. S.

University and Educational Intelligence

CAMBRIDGE.—The Vice-Chancellor announces a further gift from Dr. G. P. Bidder, of Trinity College, for the benefit of occupants of the Cambridge table at the Zoological Station in Naples. For three years Dr. Bidder has made annual payments of 5,000 lire into a Naples bank for the maintenance of occupants of the table during their sojourn in Naples. He now offers to deposit in that bank securities which, by the use of principal and interest, will provide 5,000 lire annually for the same purpose, for a further period of ten years. The professor of zoology will have discretionary powers over the fund.

The Goldsmiths' Company has made a grant of £5,500 for defraying the expenses of an investigation of the alloys of silver, to be carried out in the Metallurgy Laboratory under the guidance of Prof. R. S. Hutton, professor of metallurgy at Cambridge. The grant is to be spread over three years.

AN American "Educational Review" published as a supplement to *School and Society* of December 1 conveys the impression that school teachers in the United States are to-day very much on the defensive. Awakening from a dream of heaven-ordained security, they recognise that they have lost much of the unquestioning popular reverence they and their predecessors enjoyed for generations, and are no longer taken seriously as oracles of civic wisdom. If the President's 'new deal' is to provide old-age pensions and unemployment insurance, there will, it is felt, be a danger of these social services being financed in part by encroaching on school budgets. The same review comments on the progress of adult education with special reference to an 'alumni education' movement which is peculiar to America. Among its manifestations are mentioned a three-day conference at Seattle on present-day economic and political problems, in which a thousand alumni of the University of Washington participated, similar conferences of alumni of other universities and an annual two-week Institute of Public Affairs organised by the University of Virginia.

Science News a Century Ago

The Entomological Society

The anniversary meeting of the Entomological Society was held on January 26, 1835, J. G. Children, Sec. R.S., the president, being in the chair. After the passing of the minutes and accounts, the president delivered an address in the course of which he congratulated the Society on the progress of entomology and the favourable report which had just been read, while the secretary followed with a sketch of the progress of the science at home and abroad. The officers elected for 1835 were : *President*, Rev. F. W. Hope ; *Treasurer*, Mr. Yarrell ; *Curator*, Mr. Pickering ; and *Secretary*, Mr. Westwood.

Royal College of Physicians

The president of the Royal College of Physicians from 1820 until 1844 was Sir Henry Halford (1766–1844), who was physician in turn to George IV, William IV and Queen Victoria. On January 26, 1835, according to *The Times*, the evening meetings of the Society were commenced at the College in Pall Mall. Sir Henry Halford was in the chair and the meeting was attended by about seven hundred persons including many distinguished statesmen, lawyers and others. The meeting began at 9 o'clock and the company dispersed at 11 o'clock. The president, said *The Times*, read a very interesting paper containing some observations on the treatment adopted by medical men from a very early period, in the care of various complaints, and related many amusing anecdotes of the remedies they applied. He described the different complaints which terminated the lives of the monarchs who governed Great Britain, and also explained the circumstances attending the deaths of Addison, Dryden, Dean Swift and other distinguished characters.

Steam Navigation upon the Danube

Under the above heading, the *Athenaeum* on January 31, 1835, said : "Very gratifying accounts have recently been received of the progress of steam navigation upon this noble river. Under the auspices of the Austrian government, the whole region from Presburg to the Black Sea, and even to Constantinople, a distance of fifteen hundred miles, has lately been opened to the influence of steam. This project was first undertaken by Count Czechengi, a Hungarian nobleman of great fortune and very enlightened mind, who in quest of mechanical information, has made several journies to this country. Unlike the majority of the Hungarian nobles the Count has exhibited the most enthusiastic devotion to the improvement of his country, by the introduction of the useful arts, and his operations for improving the navigation of the Danube have been upon a scale so vast, as to entitle him to the appellation of the Bridgewater of the German States. . . ."

Societies and Academies

CRACOW

Polish Academy of Sciences and Letters, December 10. W. PIECHULEK and J. SUSZKO: New stereochemical studies. Optical isomerism of the α-phenylsulphinylphenylacetic acids. The results are in agreement with the hypothesis of two centres of asymmetry, one round the carbon and the other round the sulphur atom. K. DZIEWONSKI and MLLE. J. SCHOEN: The reactions of diphenylthiourea with the hydroaromatic ketones. WL. SZAFER: The rose genus (*Rosa*), "Polish Flora" (vol. 5). ANDRÉ SRODON: Researches on the diluvial vestiges of plants belonging to the family Nympheaceæ. MLLE. M. GAWLOWSKA: The Naïades in the Polish diluvium. Z. GRODZINSKI: Researches on the development of the vascular area in the chicken. MLLE. S. BOJARCZYK: The form of the cells of the cerebral cortex in domestic and in wild animals. Gurewicz and Szatszaturjan have described pyramidal cells in the cortex of animals in the wild state, while in domestic animals round cells have been observed. The author shows that the form of the cell depends on the mode of fixing and time elapsing after removal from the skull. MAX ROSE: (1) The hypothalamus of the rabbit. (2) The parts of the thalamus in relation with the cortex in the rabbit. (3) The metathalamus and the epithalamus of the rabbit. J. STACH: The genus *Odontella* and its species.

GENEVA

Society of Physics and Natural History, November 15. KURT MEYER: Contribution to the theory of narcosis. The author by his experiments gives support to the lipoid theory of narcosis. E. BRINER, E. ROKAKIS and B. SUSZ: Researches on the oxidation of the nitrogen oxides in the presence of ozone. M. GYSIN: The basic igneous rocks of the Haute-Lufira (Belgian Congo.) In the Haute-Lufira basin (Katanga) numerous outcrops of uralitised diabases have been observed, containing a blue soda amphibole and a little dipyre. The blue amphibole forms borders round the uralite regions; the dipyre occurs as small grains mixed with the products of the saussuritisation of the plagioclases. The uralitisation, the formation of blue amphibole and the scapolitisation can be attributed to the action of perimagmatic or apomagmatic mineralised solutions on the diabases. D. ZIMMET: A practical sphygmograph for man and animals.

MELBOURNE

Royal Society of Victoria, November 8. KATHLEEN M. CROOKS: (1) The cultural and cytological characteristics of a new species of *Mycogala*. While isolating several fungi from Jarrah (*Eucalyptus marginata*) timber a new species of *Mycogala*, *M. marginata*, was obtained. There are two types of asexual spores: (*a*) chlamydospores, spherical in shape and dark brown in colour with a thick wall when mature, and ranging from 6 to 18 μ in diameter; (*b*) oidea, formed by the transformation of aerial branches into cylindrical, hyaline elements which again break up into smaller segments one or more septate. Perithecia are abundantly developed. The perithecium initial is a coiled septate hypha—the ascogonium composed of segments at first multinucleate, but later becoming uni-nucleate. An antheridium is not developed. From the ascogonial coil ascogenous hyphæ arise. These branches are rather irregular and recurved at the tip. The ripe asci contain eight spherical hyaline ascospores, 2–4·5 μ in diameter. (2) A powdery mildew of *Boronia megastigma*:—In September and October 1933, *Boronia* growing at Healesville was found to be diseased. The disease was a 'powdery mildew' caused by a species of *Oidium*. The fungus attacked the petals while the stem and leaves appeared quite healthy. From the vegetative mycelium, aerial branches arose and at the apices of these hyphæ, oidia were contracted. The oidia were ovoid in shape and had an average size of 28 μ × 13 μ and a range of 19–38 μ × 11–18 μ. In the family Rutaceae to which *Boronia* belongs, there are few members which have been attacked by *Oidium* species, but the characteristics of the form on *Boronia* do not agree with any of those previously described. Hence it is proposed to give the fungus in question the specific name *Oidium boroniæ*. ILMA G. BALFE: Sclerote-forming fungi causing disease in *Matthiola*, *Primula* and *Delphinium* in Victoria. *Rhizoctonia solani*, Kuhn, is recorded as causing 'damping off' of *Matthiola incana* seedlings in Victoria. *Sclerotinia minor*, Jagg., is recorded as causing a collar rot of *Primula malacoides* in Victoria. *Corticium centrifugum* is recorded as causing a collar rot of delphiniums in Victoria. A description of the pathogen in culture is given, and comparisons are made between the strain isolated from *Delphinium*, Wolf's strain of *Corticum centrifugum* and Whetzel's strain of *Sclerotium Delphinii*, Welch. EILEEN E. FISHER: 'Sooty mould' of the tree fern, *Dicksonia*. A dense black film on the fronds of a *Dicksonia* plant growing in a fernery at Doncaster, 11 miles east-north-east of Melbourne, is due entirely to the fungus *Teichospora salicina* (Mont.), Gau.

ROME

Royal National Academy of the Lincei: Communications received during the vacation of 1934. G. SCORZA: The structure of pseudo-null algebras. G. A. CROCCO: Static and kinetic stability of aeroplanes. G. ROVERETO: Post-Pliocene epirogenesis of the maritime Alps and of the Ligurian Riviera. S. RIOS: The ultra-convergence of Dirichlet's series. GH. TH. GHEORGHIU: A special case of metaspherical functions. S. FINIKOFF: Couples of surfaces whose asymptotics correspond and whose homologous asymptotic tangents intersect. A. MASOTTI: The discontinuous plane motion induced in an indefinite rectilinear lamina. G. GARCIA: Einsteinian correction of the time in planetary movement. (2). N. MOISSEIEV: Curves defined by a system of differential equations of the second order. (1) A method of qualitative analysis applied to dynamic problems with two degrees of freedom. G. B. RIZZO: The influence of the terrestrial atmosphere on the effect of latitude in the intensity of cosmic radiation. The view is expressed that the influence of the bulging of the atmosphere in equatorial regions should be taken into account in considering the diminution observed in cosmic radiation at the equator. S. FRANCHETTI: Interatomic forces and oscillation frequencies of the atoms in lattices. SILVIA RESTAINO: Double sulphates of the rare-earth and alkali metals. Investigation of the system $Pr_2(SO_4)_3 - K_2SO_4 - H_2O$ reveals the existence of six double sulphates. The following compounds are also formed: $Pr_2(SO_4)_3$, Rb_2SO_4, $8H_2O$; $Pr_2(SO_4)_3$, Cs_2SO_4, $8H_2O$; $Sm_2(SO_4)_3$, Na_2SO_4, $2H_2O$ and

$4Sm_2(SO_4)_3$, $5Na_2SO_4$, $8H_2O$. P. PRINCIPI: Observations on the analogies existing between the tertiary deposits of Albania and those of central Italy. A. CAVINATO: Contribution to the knowledge of the petrography of Sardinia. A characteristic Kersantitic vein with prasinitic facies in Sarrabus. A. MIRRI: Diagnosis of *Brucella* in animals: *Brucellina Mirri*. A method is given for obtaining a brucelline preparation which serves as a sensitive means of diagnosing *Brucella* in animals, and has advantages over the agglutination test for this purpose. R. SAVELLI: Observations on some elaborates of the cells of the chlorenchyme. G. AMANTEA: The effects of slow and repeated asphyxia in an enclosed space. D. GIGANTE: Observations on the course of the reconstructive processes in the pigeon.

VIENNA

Academy of Sciences, November 8. RUDOLF KANITSCHEIDER: Mechanics of the Föhn (south wind). K. W. F. KOHLRAUSCH and F. KÖPPL: The Raman effect. (38) The Raman spectrum of organic substances (isomeric paraffin derivatives). Repetition of previous measurements and examination of a number of new compounds give results which are considered in relation to free rotatability. These results, and also the intensity differences in the spectra of paraffins containing chlorine, bromine or iodine as substituents, are in agreement with the view that the rotation leads to two different, stable space-forms. The spectral transition, $CCl_4 \rightarrow CH_3.CCl_3 \rightarrow (CH_3)_2\ CCl_2 \rightarrow (CH_3)_3\ CCl \rightarrow (CH_3)_4\ C$ is also discussed. K. W. F. KOHLRAUSCH and A. PONGRATZ: The Raman spectrum of polysubstituted benzenes. The vibration spectra of the nucleus-substituted benzenes, $Cl.C_6H_4X$, where X = NH_2, OH, F, CN, Br, or I in the ortho-, meta-, or para-position, are described.

November 14. ERNST BEUTEL and ARTUR KUTZELNIGG: The action of liquid bromine on cellulose. Contrary to previous statements, bromine is able, under suitable conditions, to dissolve cellulose fibres completely, the time required varying from several weeks at the ordinary temperature to a few minutes at 100° C. JOVAN JURIŠIĆ: The identity of *Bryophyllum cochleatum*, Lemaire, with *Bryophyllum proliferum*, Bowie, with biological remarks.

November 22. LEOPOLD PORTHEIM, H. STEIDL and F. KÖCK: Orienting investigations on the influence of ultra-short waves on blossoms. LEOPOLD PORTHEIM and O. RIED: Influence of ultra-short waves on salt solutions previously irradiated with ultra-violet light. B. NUSSBAUM and TH. SENEKOVIC: Callus formation in herbaceous plants. ERNST CHWALLA and JOHANNES JAUMANN: The magneto-elastic method for the direct measurement of forces in the iron in ferro-concrete structures. ELISE HOFMANN, WILHELM KÜHNELT and JULIUS PIA: Evergreen oaks in the alluvium of Lower Austria. EUGEN GUTH: The mutual action between rapid electrons and atomic nuclei. ERICH HAJEK: Potentiometric examination of hydroxide precipitation. ANTON SKRABAL and HELLMUT SCHREINER: Velocity of reduction of chloric and bromic acids. The velocity with which chlorates and bromates are reduced by chlorides, bromides and iodides in acid solution is proportional to the concentrations of the oxy-salt and halides and to the square of the acidity. With the bromate-bromide reaction, the velocity is proportional to the square of the concentration of the bromide, if this is high.

Forthcoming Events

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

Sunday, January 27

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

Monday, January 28

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—F. C. Fraser: "Stranded Whales on the British Coast".*

VICTORIA INSTITUTE, at 4.30.—Dr. K. B. Aikman: "Race Mixture with some Reference to Bible History".

UNIVERSITY OF LEEDS, at 5.15.—Prof. W. J. Tulloch: "The Virus Agents considered as a Problem of General Biology".*

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Miss E. J. Lindgren: "Winter and Summer Travel in the North Manchurian Woods" (Film).

ROYAL SOCIETY OF ARTS, at 8.—Dr. Harriette Chick: "Diet and Climate" (Cantor Lectures. Succeeding lecture on February 4).

UNIVERSITY OF GLASGOW, at 8.30.—Sir Robert Greig: "National Progress in Agriculture".*

Tuesday, January 29

ROYAL SOCIETY OF ARTS, at 4.30.—H. C. Sampson: "The Royal Botanic Gardens, Kew, and Empire Agriculture".

Thursday, January 31

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Dr. J. K. Fotheringham: "Ways of Measuring Time—Ancient Clocks".*

Friday, February 1

WESTFIELD COLLEGE, LONDON, at 5.15.—Sir Arthur Eddington: "Cosmic Clouds and Nebulæ".*

ROYAL INSTITUTION, at 9.—Prof. F. Simon: "The Approach to the Absolute Zero of Temperature".

Official Publications Received

GREAT BRITAIN AND IRELAND

County Borough of Southport: Meteorological Department. The Fernley Observatory, Southport. Report and Results of Observations for the Year 1933; with an Appendix. By Joseph Baxendell. Pp. 31. (Southport.)

Ministry of Agriculture and Fisheries. Collected Leaflets, No. 3: Diseases of Potatoes. Pp. iv+74+9 plates. (London: H.M. Stationery Office.) 1*s.* 6*d.* net.

Board of Education: Science Museum. Rubber Exhibition (November 1934–April 1935). A Brief Account of the History of Rubber from its Source to the Finished Product and a Descriptive Catalogue of the Exhibits. Compiled by the Rubber Growers' Association. Pp. 44+4 plates. (London: H.M. Stationery Office.) 6*d.* net.

OTHER COUNTRIES

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 83: Natural Pastures; their Response to Superphosphate. By Dr. J. Griffiths Davies, A. E. Scott and K. M. Fraser. Pp. 76. Pamphlet No. 49: Some Important Poison Plants of North Australia. Compiled by the Poison Plants Committee. Pp. 44. (Melbourne: Government Printer.)

Smithsonian Institution: Freer Gallery of Art. Oriental Studies, No. 2: A Descriptive and Illustrated Catalogue of Miniature Paintings of the Jaina Kalpasûtra, as executed in the Early Western Indian Style. By Prof. W. Norman Brown. (Publication 3252). Pp. v+66+45 plates. (Washington, D.C.: Smithsonian Institution.)

Contributions from the Physical Laboratories of Harvard University for the Years 1932 and 1933. Vol. 22. Pp. iv+506. (Cambridge, Mass.: Harvard University.)

Department of Agriculture, Trinidad and Tobago. Vol. 1, Part 6: Flora of Trinidad and Tobago—Myrtales (Pars). By R. O. Williams. Pp. 333–410. (Trinidad: Government Printer.) 3*s.*

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MACMILLAN & CO., LTD.
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Telephone Number: WHITEHALL 8831
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