NATURE

SATURDAY, OCTOBER 11, 1924.

CONTENTS.

	PAGE
The Abrams' Cult in Medicine. By W. B.	525
Science and the British Empire	526
Rejuvenation. By Dr. F. A. E. Crew	530
Our Bookshelf	531
Letters to the Editor :—	
The Physical Nature of Verse. (*With Diagrams.*) —Prof. E. W. Scripture	534
A Possible Origin of Contracted Burials.—Dr. Henry O. Forbes	535
The Choice of Wave-lengths for Achromatism in Telescopes. (*With Diagram.*) — Prof. T. Townsend Smith	536
Lake Victoria and the Flow of the Yala River.— Norman L. Silvester; C. E. P. Brooks	536
Analytical Sound Records. (*Illustrated.*)—Dr. E. E. Fournier d'Albe	537
Mendelism and Evolution.—J. T. Cunningham	537
The Indian Institute of Science, Bangalore.—Prof. S. S. Bhatnagar	538
Gravity Measurements in Deep Water.—Prof. J. Joly, F.R.S.	538
The Institute of Catalan Studies at Barcelona.— John Langdon-Davies	538
Geology and Evolution. By Prof. W. W. Watts, F.R.S.	539
Liquid Air in Mine Rescue Apparatus. (*Illustrated.*)	543
Obituary :—	
Dr. S. H. C. Martin, F.R.S.	545
Mr. F. H. Bradley, O.M. By Prof. J. H. Muirhead	546
Mr. H. G. Smith	547
Current Topics and Events	547
Our Astronomical Column	550
Research Items	551
Ferrous Alloys Research: The Iron-Oxygen Equilibrium. (*With Diagram.*) By H. C. H. C.	554
Seasonal Changes in Shell-fish	555
Tests for Scholarships and Promotion	556
Vegetative Propagation in the Tropics	556
University and Educational Intelligence	557
Early Science at the Royal Society	558
Societies and Academies	559
Official Publications Received	559
Diary of Societies	560

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON

NO. 2867, VOL. 114]

The Abrams' Cult in Medicine.

IN our issue of June 7 we published an article on "the Abrams' Cult in Medicine" and indicated that the claims made on behalf of the late Dr. Abrams were without scientific foundation. One of the many ridiculous diagnoses made by means of the so-called electronic dynamiser was quoted, and the methods employed by the "electronic reaction Abrams" (E.R.A.) were described. In the July, August, and September numbers of the *Scientific American* there is an extensive report of a committee of experts appointed by that journal to inquire into the actual facts of the case. The committee consisted of thoroughly trained medical and electrical investigators, including such well-known men as W. H. Park, W. C. Alvarez, R. C. Post, and J. M. Bird, with A. C. Lescarboura as secretary. These men have spent a year chasing the elusive methods of electronic medicine. They have interviewed and co-operated with electronic practitioners and experts in the new cult, and the result is disastrous to the reputation of Albert Abrams.

The report of this committee is in what may be described without offence as the characteristic American style—interesting to those on the eastern side of the Atlantic. The authors of the report state that the "Electronic Reactions of Abrams are not substantiated, and it is our belief that they have no basis in fact. In our opinion the so-called electronic reactions do not occur, and the so-called electronic treatments are without value." In another place the committee states that "the entire Abrams' electronic technique is not worthy of serious attention in any of its numerous variations. At best it is an illusion. At worst it is a colossal fraud."

The *Scientific American* committee gives a clear account of the genesis of the Abrams' myth, and shows how the Californian Cagliostro's claim that the basis of life is bound up with the movements of electrons is a question which does not admit of proof. On the electronic basis, however, Abrams invented a mysterious box called a dynamiser for collecting the electronic emanations, and elaborated a portentous system in which diagnoses of the most obscure ills of life were said to be possible, at a distance of thousands of miles, from the emanations given off by a drop of blood on a disc of blotting-paper. Not only the disease of the patient but also the height, habitus, colour, sex, and religion were said to be capable of revelation by the dynamiser—a childish toy which defies all the laws of electrical science. In one of Abrams' own demonstrations he placed in the dynamiser a photograph of a man and foretold his disease as insanity due to syphilis, and on running the electrode across a map of America

it stuck at Stockton, California, which was consequently proclaimed as the patient's address!

By judicious advertisements and newspaper "puffs" by credulous persons and those in quest of sensational material for the press, Abrams' claim to diagnose disease at a distance was soon noised abroad, and Abrams founded a school rich in financial possibilities. He then added to the diagnostic scheme one of electronic treatment, thus providing a wider field for commercial exploitation. New companies sprang up to manufacture the Abrams' dynamisers and oscilloclasts at fancy prices. Schools for training Abrams' practitioners were founded, and a motley array of medical men, osteopaths, chiropractors, and electronaturopaths hied them to sunny California to sit at the feet of Gamaliel and hear him expound the new science. Within a few years, more than three thousand practitioners of electronism were trained for their life work in the United States alone. They found that there was a rich harvest in dollars, in comparison with which ordinary medical practice was a poor profession.

When one reflects that we are living in the twentieth century, and that both medical and lay people can believe something which has no meaning, it is clear that there is no limit to credulity. There have been great humorists in history, but Dr. Albert Abrams of California must surely head the list. To invent a new form of energy which cannot be tested by any known method except by the five senses of Abrams and his pupils is something of an achievement. To determine the sex of a child *in utero* from a drop of the blood of the father a thousand miles away is asking one to believe a good deal. To explain errors in electronic diagnosis in California by wireless disturbances on the Eiffel tower in Paris or activities on the planet Mars is perhaps reasonable from the electronist's point of view. To expect, however, your fellow-creatures to believe all this nonsense, and to earn vast sums of money by the delusion, may be classed as a form of humour to which our psychologists and mental philosophers have not paid due attention. Although the *Scientific American* committee has exposed the absurdity of Abrams' system, it does not follow that its labours will be crowned with a universal success, for in all probability there will still remain hundreds of genial persons who do not mind paying their dollars to hear the joyous tick-tack of Abrams' oscillating metronome.

We live in an age of science, but it is as easy now as ever it was for the charlatan to impose on the credulity of the public. The penalty of great scientific achievement seems to be that people are ready to accept the most astounding claims, provided they are put forward in the name of science. W. B.

Science and the British Empire.

The Resources of the Empire Series. Vol. 1, Part 1: *Crops and Fruits.* By J. R. Ainsworth-Davis. Pp. 144. Vol. 1, Part 2: *Meat, Fish, and Dairy Produce.* By J. R. Ainsworth-Davis. Pp. 104. Vol. 2: *Timber and Timber Products: including Paper Making Materials.* Edited by S. J. Duly. Pp. 228. Vol. 3: *Textile Fibres and Yarns.* By J. S. M. Ward. Pp. 192. Vol. 5: *Rubber, Tea, and Cacao; with Special Sections on Coffee, Spices, and Tobacco.* Compiled and edited by W. A. Maclaren. Pp. 334. Vol. 6: *Leather, Hides, Skins, and Tanning Materials.* By Dr. E. C. Snow. Pp. 368. (London: Ernest Benn, Ltd., 1924.) 21*s.* net each vol.

EVEN in these days, people still occasionally refer to science, or at least to natural science, as to a subject of purely academic interest, though remarkable changes have been made during the last thirty years. In the lifetime of the present writer it has been of interest to watch the gradual penetration of the methods of the natural sciences into many branches of knowledge. Many subjects, formerly holding themselves more or less aloof, are now permeated by scientific method, and work upon lines as scientific (or knowledge-making, for that is what the word implies) as are those of such a science as botany, at any rate, even if not yet of such a science as physics.

The world is, indeed, gradually realising that science simply means organised and reasoned knowledge, without which rapid progress is almost impossible. Knowledge is good, and organisation is good, and by their combination there are opened up possibilities of progress to which we can see no limit. Both knowledge and organisation are necessary for satisfactory and efficient work, yet the combination of the two was long looked at askance, probably because it was first applied to subjects that seemed to have little or no bearing upon practical life. With the proper organisation of inductive knowledge, general laws of ever wider application begin to appear, progress becoming more and more rapid as deduction becomes more and more possible.

Such being the case, it is a little difficult to draw the line in referring to developments in the British Empire due to science, for which the volumes in question are serving as the text. Engineering, the most important of all as yet, must, of course, be considered, and also the rapidly growing science of agriculture, which is the strong basis of the art of agricultural practice.

Scattered over the four quarters of the globe as it is, the British Empire has an enormous variety of resources, and there are few things required by modern civilisation which it cannot if needful produce. The

first necessity, however, is security of life and of property, and this scattering of the parts makes the Empire more vulnerable, necessitating the keeping up of a great fleet, in which the application of science is manifest in almost every detail.

The second great necessity is an adequate population for the various parts of the Empire, and this presents perhaps the most difficult problem that lies before our statesmen at the moment; for there is no doubt that except in the British Isles, in India, and a few West Indian islands, the population is absurdly inadequate. Australia and Canada with their enormous areas have, one rather less, the other rather more, than two people per square mile, against 7 in Argentina and 9 in Brazil, to take countries of similar sizes and ages. Important though this problem is, however, scientific knowledge of the many questions involved is as yet only in the early stages of organisation, and one can scarcely draw deductions upon which it is safe to act. Science is rapidly entering very largely into the question, however, with the wonderful discoveries of the last half-century in medicine, bacteriology, surgery, etc., discoveries which have saved great numbers of lives, and have much improved efficiency.

As the population grows, so also must the food-supply, and the present condition of that of the Empire affords an interesting study. At the headquarters of Empire there is no pretence at growing enough food for the people—the fact that the British Isles are admirably situated and equipped by Nature for a manufacturing country, added to the ordinary laws of supply and demand, have ordained that the population shall outgrow the local food-supply, and live largely by export trade, obtaining food in exchange. In this exchange, the countries of Europe, and the United States, with their large populations causing a large demand for manufactured goods, and with their nearness to the British market, have an advantage over most of the Empire countries, though Canada and others with increasing population are steadily taking an increasing share in the supply of the comparatively non-perishable food-stuffs such as wheat, or of those that can be sent in cold storage. The general tendency at the present time seems to be in this direction, with increased attention at home to the more perishable supplies of food, at present largely imported from the Continent.

The other Empire countries usually grow enough food for their own people, though some, like Ceylon, are strange exceptions, and they have often a fair amount left over for export to Europe or to whatever market is most suitable and profitable. When the market is very attractive, as, for example, the British market in wheat, they tend naturally to make a special business of growing for it. Parts I. and II. of the first of the volumes under consideration, from the able pen of Prof. Ainsworth-Davis, deal with the food of the Empire, with full statistics of production, trade, etc., and place before the reader an organised mass of detailed information upon the subject, from which, by aid of the further necessary equipment of a scientific mind, it is possible to deduce promising lines upon which to act. What at present seems to be chiefly required is the more complete application of science to agriculture, to ensure a greater, more profitable, and more economic yield of the food crops. This is especially needful in Britain itself, in order that the country should produce more food, and thus be more secure in the event of another great war, though it seems unlikely that the country will ever be able to dispense with import upon a large scale, even of the first elements of food, which is all that we are at present considering. In the rest of the Empire, work of this kind is just as useful, inasmuch as it may diminish cost of production of necessities, and thus set free more labour for leisure and luxury.

Now this in fact is what is actually happening all over the world. By the study of pests and diseases, for example, science has rendered, and is rendering, great service to those who suffer from them, and by checking their ravages is thus increasing the yield and profitableness of both plant and animal husbandry. By a proper chemical study, the art of cheap and efficient manuring has become much better understood, thus providing greater increases of yield at less cost than formerly. Similar results have been obtained by the proper study of the feeding of animals. The rise of Mendelism in recent years has enabled us at any rate to make a commencement in the direction of breeding upon scientific lines towards a desired end, instead of merely taking "the gifts the gods provide." Already results are being obtained, for example, with Prof. Biffen's new wheats, that may lead to great developments in the near future. Fruit and vegetable growing, and all other forms of agriculture and horticulture, are similarly receiving close attention at the hands of properly trained men, as are the fisheries and the study of domestic animals.

In the Dominions, on the other hand (as in the United States), the scarcity of labour has tended to make the scientific development of labour-saving one of the most important directions of research, whilst the impossibility of carrying many food-stuffs to Europe in their natural fresh condition has stimulated research into methods of canning and of cold storage, both of them lines in which much work is now being done, and considerable trade springing up.

Not only must the people be fed, but they must in

general be clothed also, to at least the minimum degree prescribed by local custom; and in this connexion the volume upon fibres (Vol. 3) comes in useful. By far the most important fibres for clothing are cotton and wool, and of the latter the Empire produces a very large proportion of the world's supply. On the other hand, the position in regard to cotton is not one in which to sit with folded hands. Of short-stapled cotton the Empire produces the bulk of the world's supply, in India, and with it clothes a great part of the population of that country, besides exporting much to Japan and elsewhere. But of the cotton of medium and long staple, such as is used in Lancashire, the Empire produces less than 200,000 bales, against a world consumption of about 15 or 16 millions, when it ought to produce about 25-30 times as much, and with the falling-off in the supply from the United States, bids fair to get into difficulty.

This position has long been foreseen, and the British Cotton Growing Association was formed more than twenty years ago to deal with the question, but of late there has been added to this body, which has done a very great amount of valuable pioneering work under great difficulty, the powerful Empire Cotton Growing Corporation, which, though not directly a department of Government, but managed chiefly by far-seeing and capable Lancashire business men, received Government aid in an endowment, and in a compulsory cess upon all cotton used in Great Britain. Nothing could show more clearly the strong position that science now holds than does the work of this Corporation, which supports financially the work in many scientific institutions, trains its future workers in science laboratories in England and elsewhere, and in general acts upon what may rightly be called scientific lines.

So old and so long established are the weaving industries, and so entirely do they depend upon mechanical methods, that as yet there has been comparatively little intrusion of scientific methods into them other than in the constant improvement of the machinery.

Leather, upon which there is a volume (Vol. 6), may also be mentioned here, inasmuch as shoes (or sandals) have ceased to be a luxury, and have become a necessity to a great many. The large size of the volume just mentioned, compared with the small size of that dealing with the food-stuffs, prompts the reflection that the work is somewhat unevenly proportioned; the volume dealing with tea, cacao, coffee, and rubber is almost equally large. To return to leather, since the Empire contains about 40 per cent. of the animals which furnish it, there is no reason to fear any shortage.

The people must also be housed, and in this connexion the volume upon timbers (Vol. 2) is useful as indicating the resources of the Empire in one of the principal materials used in housing and furnishing. In most of the tropical colonies, and in India, the housing is simple, of type varying with the materials that are most readily obtainable locally, for example, bamboo in Malaya, mud-and-wattle in Ceylon (with a tendency to replacement by kerosine tins), and the like. But in the white portions of the Empire, with their colder climate, housing has become more standardised, and only perhaps since the War is there any tendency to alter long-established custom, or to invoke the aid of scientific knowledge in building.

We may take it then that as the Empire increases in population it will be able to feed, clothe, and house the people without any falling-off from the present standards, the necessary corollary being fulfilled that adequate and economical transport be provided to link up its different parts, some of which will provide one item, some another.

A country in which the people are merely fed, clothed, and housed, upon the lowest terms (so to speak), cannot, however, be called rich, prosperous, or progressive. The possession of riches implies the power of obtaining the best of everything in the greatest variety, and the possession of sufficient leisure and education to enjoy travel, art, music, literature, and the other adornments of life. The possession of wealth that goes beyond this confers little upon its owner but power, and it should chiefly be used as investment. There is therefore something to be said for the gradual diversion of such wealth to the use of the State as a basis for the improvement of the position of all alike. It must not, of course, be supposed that many people possess, or are likely in the near future to possess, riches enough to command all that has been indicated, but most people strive to obtain as much as possible, some in one direction, some in another; and tastes differ.

For this amelioration of the conditions of life, which has long been going on, and will, it may be hoped, long continue, many things are necessary, not the least among which is an extensive exchange of products between one country and another, involving cheap and good transport. Life would be a poorer thing in Britain had we no sugar or spice, no rice, sago, or tapioca, no tea, coffee, or cocoa, no rubber, no wine or tobacco, no oil (whether mineral or vegetable), with its concomitant no soap, no cotton or jute, no gold or silver, no bananas, oranges (marmalade), grapes, currants, raisins, or many other things, to say nothing of our import of many of the basal necessities of life. The great dominions and the smaller colonies are equally deficient in many things needful to make life

comfortable as judged by our present standards, and without the present extensive trade that goes on, life would soon be reduced to very simple terms once more. Transport, upon its present efficient lines, has only been rendered possible by the work of engineering science, and improvement continues to be made almost daily.

Whilst there is scarcely any country in the world now unprovided with the comparatively cheap steamship transport, the development of land transport still leaves much to be desired. It goes, as does the former, with the development of sufficient trade to make it pay its way, or roughly with the growth of population, though a tendency is now becoming clearly marked for roads and railways to be made in advance, to encourage the growth of population, agriculture, and trade. Air transport, which may at any time become of enormous importance, need only be mentioned here. An important concomitant of transport is rapidity and ease of communication. At first dependent directly upon the former, it has now become to a considerable extent independent of it, as witness the wonderful feats of science in the invention of the telegraph and the telephone, at first with wires, and now without, the invention of "wireless" promising to revolutionise the world in this direction at some not very distant date.

In the provision of what we may term the luxuries, that make life more enjoyable, and that give a real and tangible value to monetary wealth—luxuries that one by one come to be regarded as necessities—science has had a very large and increasing share, which may be briefly indicated. But it must be realised that all parts of the question hang together, and that progress in one can only accompany progress in another. Progress in general is slow, but every now and then some great genius appears, whose invention or discovery involves change in many departments of life.

Agriculture (in the broadest sense), and mining, provide the great bulk of the raw material of wealth, but transport, and more or less of manufacture, are generally needed to make it really available for use. In early days agriculture was (of necessity) conducted mainly upon the principle of "grow-what-you-want-and-consume-what-you-grow." Gradually, with the improvement of transport systems, a certain amount of specialisation came in, whilst a considerable trade sprang up in the products of wild trees or plants, which could be collected without cultivation, and were worth while, such as rubber, gutta, cinchona, cinnamon, and many other things.

While at first the products of any country were such as were native to it, this gradually altered with the improvement of transport, and the useful plants and animals of one part of the world were carried to others, at first often to places quite unsuited to them. Thus, at the present time plants are cultivated for market quite irrespective of their countries of origin, though in a few instances, such as cinnamon in Ceylon, the original country has retained a practical monopoly. Even up to quite recent times there have been striking examples of the success of introduced cultivations in new countries, as witness the rubber boom of a few years ago, and the present extension of cotton in tropical Africa. But this phase must necessarily pass, inasmuch as everything will soon have been introduced into all the countries where it will be likely to succeed. At the same time, the great extensions of cultivation thus brought about have often reduced the profitableness of a cultivation to a very low point. On both counts the aid of science is now being called in, and the next phase of agriculture will be the scientific. It is almost needless to say that science has always had more or less to do with agriculture, for example, by means of the Botanic Gardens maintained in many places; but there is no doubt that its share in agriculture is increasing all the time, so that cultivation may be said to be becoming more and more scientific, both in itself and in its accessories, such as disease-prevention and the like.

While the necessary elements of food have been practically always available in ample quantity, luxury in food continues to increase, and many things once regarded as luxuries are now usually counted as necessities, such, for example, as tea, coffee, cocoa, spices, and tobacco (to call this a food for the moment), to which Vol. 5 is devoted. Improvement in food is due to many things, but chiefly to greater variety of origin (with which of necessity goes the transport to carry it to other places), and to improvement in the actual kinds of animals or plants used. In both of these, but more especially in the latter (by improved breeding), science has had a large share, and will probably have a larger share as time goes on.

Fibres in the same way are being provided from an increasing number of sources, and their uses are being extended, while at the same time, by the application of science to cultivation and treatment, the yield is being increased, and the quality improved. The great need before the Empire at the moment is to increase the production of good cotton within its boundaries.

New timbers, too, are being discovered, and new uses for timber, but there is still much room for the application of scientific method. If some way of exploiting the mixed forest of the tropics could be discovered, which would place at the disposal of mankind its great riches in many valuable timbers and other products, a great service to humanity would be done.

To the achievements of science in adding new amenities to life one cannot refer in detail; let it suffice to direct attention to such things as the telegraph and the telephone, to rapid and comfortable travel by steamboat, by rail, by road, by the motor and the aeroplane, to wireless communication (including listening-in), and to innumerable other inventions, only rendered possible by scientific discovery and its application.

The problem now, and probably always, before us, is to increase the supply of the luxuries of life, and make them more available to every one, while at the same time cheapening the cost of production of the necessities and setting free more labour to be devoted to the former. At the same time, for a long while to come, we must allow for a continually increasing population. There are obviously many factors that come into this problem, including, for example, increased efficiency—best brought about perhaps by the careful application of statistical and other science to the problem in hand and by better education—and greater and more economical application of power derived from coal, from oil, from water, and from other sources as yet untapped, and only to be tapped by the careful application of science; and many other factors which determine human progress.

For such work as now outlined, haphazard methods are of little or no use; we require our knowledge systematised and organised to the highest degree possible at the moment. It is for this reason that one welcomes the publication of such volumes as those under consideration, appearing at the same time as the great exhibition at Wembley, which lay before us a clear picture of the actual resources of the Empire, so far as they are at present known. That many more remain to be discovered by the aid of scientific research need scarcely be said of course, though one must in passing note the interesting fact that in agriculture, at any rate, the knowledge and skill of the white man has added comparatively few products, and none of first-rate importance, to those which were known in prehistoric days. Economic botany, which requires its main assistance from organic chemistry, is as yet too much of a chaos of facts, with few general laws that we can yet see that underlie them, to be of any use in making predictions. This, however, will doubtless be altered in time, and with the wonderful improvements in breeding that are taking place as a result of Mendel's work, we may look forward to the future breeding of economic plants "to order." The heyday of empirical practice has passed, and the future appears to lie with scientific (or organised and classified) knowledge. It is for statesmen to see that the power which this knowledge gives is used for the well-being of mankind.

Rejuvenation.

Rejuvenation and the Prolongation of Human Efficiency: Experiences with the Steinach-Operation on Man and Animals. By Dr. Paul Kammerer. Pp. 252. (London: Methuen and Co., Ltd., 1924.) 8*s.* 6*d.* net.

WHEN a new development in science has provided the low comedian with material for jest and the popular author with a plot, when from the biassed misinterpretation of the journalist it appears that a discovery has been made that must revolutionise the life of the individual and of the community,—then it is high time that some one with a training in that particular branch of science and in scientific method, and with a literary ability that enables him to interpret to the man-in-the-train, should give a popular presentation of the facts and the theories based upon them, so that all those who seriously seek information on this subject can glean it. A book in English dealing with the operative methods of achieving rejuvenation and giving in a legitimately popular form a critical review of the work of Steinach, Voronoff, and their followers has, therefore, been expected for some time; and this is attempted in the volume before us.

The interested general public wants to know current biological opinion concerning the cause of ageing and death; it wishes to learn whether and how one can be compensated and the other postponed. Is ageing the result of the accumulation of the effects of auto-intoxication, of inefficient excretion of the deleterious end-products of metabolism? Is one of the functions of the glands of internal secretion to purify and vitalise the whole body; and are these glands so interdependent that if one comes to function less efficiently, the whole endocrine system is thrown out of gear? Can the adequate functioning of the endocrine system in these circumstances be re-established by operative measures that repair the weak link in the endocrine chain? It is on the assumption that the answer to all these questions is in the affirmative that rejuvenation has been attempted deliberately by injection of extracts, by the implantation of glandular tissue, and by the ligation of the deferent duct of the testis in the male.

It is claimed that specific and demonstrably beneficial results follow such treatment in the human subject, in farm stock, and in the laboratory mammal. It is desirable that this claim should be examined most carefully, particularly in the case of the human, for here it is always necessary to allow for the effects of suggestion. There is plenty of evidence available for this examination, and of such a kind as to lead to the conclusion that it is possible in suitable cases to achieve rejuvenation.

As for the methods to be employed, that of injection of such extracts as are available at present is utterly untrustworthy; for the implantation of grafts an adequate supply of human or simian gonad is required, and this is not easily maintained; unilateral ligation of the deferent duct of the male, on the other hand, is a simple operation that has often been performed, though Steinach was the first to do so for the definite purpose of bringing about the rejuvenation effects.

If the Steinach operation is followed by demonstrable improvement in the general well-being of the individual, and there is considerable evidence which seems to show that it is, then this operative procedure must quickly find its way into human and veterinary surgery. For example, it would mean much to the stock-breeder to be able to get another year's crop of offspring from a famous sire.

Rejuvenation in the female is an altogether different matter. Not nearly so much work has been done in this field. The most promising method would seem to be that of irradiation of the ovaries with X-rays; this leads to sterility, but at the same time, it is claimed, to rejuvenation.

The whole question is being followed with the greatest interest by the medical man who has to prepare himself for the giving of advice, and by the patient who is inclined to seek it. For the former there are the medical journals; for the latter there are the newspapers, and now we have Dr. Paul Kammerer's survey of the subject.

Reading this book, one gains the impression that it is a literal translation of a German manuscript into an Americanised English by one who is not a physiologist. It is full of phrases that startle and hurt both the man of science and the grammarian, and about it there is far too much that savours of advertisement. It is true that the facts concerning the methods and the results of the operative treatment of old age will be found in the book, but far too frequently they are completely obscured by a painful misuse of the English language, by a lack of knowledge of the author's meaning, and ignorance of physiological terminology on the part of the translator.

The book suffers also, and severely, from the too strenuous effects that were made to present the subject in a popular form: there is a degree of popularity offensive to the professional scientific worker, who cherishes the dignity of his science. The subject is a most fascinating one, for throughout the ages man has yearned for immortality and has ever schemed to achieve it. A most excellent popular book could be written about it: in our opinion, it still remains to be written. F. A. E. CREW.

Our Bookshelf.

Time Measurement: an Introduction to Means and Ways of Reckoning Physical and Civil Time. By L. Bolton. (Bell's Natural Science Series.) Pp. viii+166+8 plates. (London: G. Bell and Sons, Ltd., 1924.) 6*s*. net.

IN this book the author has aimed at giving the rudiments of time measurement to readers possessing no previous knowledge of the subject. The first forty pages deal with the nature of time measurement and of the more prominent natural cycles (the year, the day) suitable for the purpose of measuring time. To assist the reader towards an exact understanding of the astronomical terms involved, the author insists upon the use of the globes and the armillary sphere, and describes in full detail a cheap home-made example of the latter instrument.

Early time-pieces (water clocks, sand clocks, and sundials) for subdivision of the day by artificial means are next briefly described. This is followed by a chapter on weight-driven clocks of the thirteenth and fourteenth century, descriptions being given of De Vic's clock (*c*. 1370), the Wells clock (*c*. 1393), and the Dover Castle clock. Photographs are shown of the two latter examples, which have for many years been exhibited in going order in the Science Museum at South Kensington. The author directs attention particularly to this chapter and a later one dealing with striking mechanisms, pointing out that though of rough workmanship, these early machines were anything but crude in conception, and expressing the hope that "the reader who studies these chapters will be left with an enhanced respect for the attainments of the Middle Ages."

Other chapters deal with the work of Galileo and Huygens; Hooke, Graham, and Harrison; driving mechanisms; watches and chronometers; electric clocks; Greenwich mean time; the calendar. Though the few short biographical notes woven into the text in some cases throw unduly into relief certain personal imperfections (Hooke—"unlovely character," "unhappy miser," "stinginess"; the two Scaligers—"not entirely reliable in personal matters, and altogether they seem to have been unpleasant people to deal with"), the book as a whole deserves commendation as a good introduction to its subject, especially for the class of reader for which it is intended.

Sunshine and the Dry Fly. By J. W. Dunne. Pp. v+136. (London: A. and C. Black, Ltd., 1924.) 5*s*. net.

MR. DUNNE's book will be read with great interest by the devotees of dry-fly fishing, if only for its unorthodoxy, amounting almost to heresy, in its attitude to the works of Halford, hitherto regarded as the standard works on the art of dry-fly making, and slavishly used by most anglers. The author objects that Halford obtained the colours of his dry flies from the natural flies seen under wrong conditions of light, and that his record of colour is therefore erroneous. Mr. Halford placed the natural flies on their dorsal surfaces in a white saucer and allowed strong light to fall on their ventral surfaces, and in this way sought to obtain the colours of the fly as seen by the fish. As Mr. Dunne

points out, this method reduced the light showing through from the back of the fly and increased that reflected from the ventral surface, with the result that Halford's colours are darker than they should be. Further errors crept in from the use of preserving fluids, which materially altered the colour of the natural flies preserved in them for copying purposes.

Mr. Dunne seeks to remedy these two sources of error. He avoids the use of preservatives for his models, and studies their colour by placing them on a glass plate in their natural position, dorsal surface uppermost, and examining them from below against the sky, thereby reproducing more closely the conditions under which the fish sees them. From this point of view the author has reviewed Halford's work and produced a new series of dry-fly patterns, full directions for the tying of which are given in a valuable appendix. He has also experimented with the view of imitating more closely the translucence of the natural models, and claims to have succeeded even beyond his hopes. Mr. Dunne's book is vigorous and stimulating, and deserves careful study by his fellow-sportsmen.

A Dictionary of Applied Chemistry. By Sir Edward Thorpe; assisted by Eminent Contributors. Revised and enlarged edition. Vol. 5: Oxygen to Rye. Pp. viii+722. (London: Longmans, Green and Co., 1924.) 60*s.* net.

THE fifth volume of the new edition of Thorpe's "Dictionary of Applied Chemistry" has recently been issued, covering the section from Oxygen to Rye. This section has been enlarged from 570 to 722 pages. The most important additions are a new article on "Electrical Precipitation" by Dr. H. J. Bush, covering 17 pages and containing 20 figures, and a new article on "Refractories" by Dr. J. W. Mellor, which covers 10 pages and contains 6 figures. The article on paints has been expanded, in part by a fuller discussion of white pigments, including the debated question of regulations for the use of lead paints, and a new paragraph on fillers and extenders. Prof. J. F. Thorpe's article on phenols has grown from 10 to 13 pages, and Dr. Hewitt's article on quinones from 45 to 50 pages. Still more considerable expansion is found in the article on photography, which has grown from 35 to 51 pages; and the 10-page article on radioactivity now covers 23 pages (under the heading of radiology), mainly as a result of the addition of a 12-page section on X-ray spectroscopy, over the initials of Dr. E. A. Owen. Only one important example of shrinkage has been detected by the reviewer, namely, an omission of 7 pages on Scheele's method of preparing phosphorus, the details of which are now disposed of in two lines, by a statement that "Full details of this practically obsolete method were given in the last edition of this work." Chemists and others will be glad to add the new volume to their shelves, and will find that the revision has added substantially to its value.

Algebras and their Arithmetics. By Prof. L. E. Dickson. (University of Chicago Science Series.) Pp. xii+241. (Chicago: University of Chicago Press; London: Cambridge University Press, 1923.) 2.25 dollars.

THE existence of various systems of algebra, in which the commutative and associative laws of ordinary algebra are not assumed to be valid, has been known to mathematicians since Hamilton expounded his theory of quaternions. Such systems of non-commutative and non-associative algebra, based on a set of postulates consistent with itself, are now termed *linear*, and the general entity of a linear algebra, a hypercomplex number, marks the final stage in the evolution of number. The first half of Prof. Dickson's book expounds the theory of linear algebras and explains the terminology adopted in their classification. Only moderate mathematical attainments in the reader are assumed, and, apart from the development of the subject-matter, the book will be of great value to those interested in the foundations of mathematics.

The theory of arithmetics of algebras has been surprisingly slow in its evolution. Naturally, the arithmetic of quaternions received attention first, a successful theory being obtained by Hurwitz in 1896. In passing to the arithmetic of any rational algebra the first main difficulty lies in rightly defining the integral elements. The early attempts of Du Pasquier soon led to insurmountable difficulties which are discussed by Prof. Dickson. By adopting a new definition the author has been able to develop a new arithmetical theory, valid and self-consistent in any rational algebra. As yet the theory is only in its infancy: it leaves open a promising field for the research worker.

W. E. H. B.

The Book of the Wandle: the Story of a Surrey River. By Dr. J. M. Hobson. Pp. xii+196+16 plates. (London: G. Routledge and Sons, Ltd., 1924.) 10*s.* 6*d.* net.

THE short Wandle river is historically of some importance, and Dr. Hobson has honoured it by writing a book about it. Owing to its rapid fall it has worked numberless mills from time immemorial, and we should have wished to have learned more about it as a source of water-power, such as that given by Close in connexion with the Southampton Itchen. Otherwise we have in this book a comprehensive account of the Wandle's genesis and geology, its fauna and flora, its industries and its many literary and other associations. Written in popular style, it contains much valuable information, collected mostly from the Proceedings of the Croydon Natural History Society, which is to be congratulated on the valuable work that its members have done.

The author rightly points out that intermittent bournes often show the extended courses of present-day dwindled rivers, and the Croydon Bourne shows the former course of the Wandle. If ever it came over what is now Pebble Coombe may be doubtful, although Chipstead valley, Smitham Bottom valley, and Caterham valley no doubt once fed the river. As the valley from Marden Park furnishes so much water to the Bourne now, sufficient importance perhaps has not been given to this branch of the former Wandle, as we should imagine that this branch was of later persistence than that from Merstham, although we recognise that the latter pass is a good deal lower than the Marden Pass.

We may point out that a vallum of the Romans was not necessarily made of stone, although Dr. Hobson thinks that such places as Walleton (Wallington) derive their names from the "Welsh," who were left in possession of them by the Anglo-Saxons. The book is well illustrated, and is full of information relating to the wide area drained by the little river which it describes.

A Manual of Land and Fresh Water Vertebrate Animals of the United States (Exclusive of Birds). By Prof. H. S. Pratt. Pp. xv+422. (Philadelphia: P. Blakiston's Son and Co., 1923.) 6 dollars.

THE naturalist frequently finds that to learn to identify species is a most difficult task, and yet nothing is more important to his work. He finds that species are not separated merely on shape and colour, but on structural peculiarities which frequently are connected with particular habits. This is especially the case in vertebrate animals, which in Great Britain, with its very limited number of forms, may be identified in a haphazard manner by elimination. This is impossible in a country where different climatic areas interdigitate and where there are many species, as the United States, which for the purpose of the naturalist is a continent. Here Prof. H. S. Pratt "fills the bill" by his "Vertebrate Animals of the United States," which, however, omits birds. A short account of each group is given, the anatomical features dividing it up into sub-groups and families being usually illustrated. Where necessary, special features for families are described and then follow keys to the genera, descriptions of the same and keys to their species. The whole closes with a good bibliography and a glossary of technical terms. The short descriptions of each species, with mention of their geographical distributions and habitats, are excellent, and the tabulation of the sub-species most useful. We learn that there are about 600 species of freshwater fishes, 70 of newts and 61 of frogs and toads —we are given a key by which their tadpoles and eggs can be identified—300 reptiles and a wide series of mammals belonging to 9 orders. We characterise this publication as a book for ready reference, such as should be on the shelves of all American naturalists.

Automatic Telephone Systems. By William Aitken. Vol. 3: Large Multi-Office Automatic Systems; Semi-Automatic Working; Miscellaneous Systems; Lay-out and Wiring; Power-Plant, Traffic. Pp. xv +239. (London: Ernest Benn, Ltd., 1924.) 55*s.* net.

THE Strowger Director System of automatic telephony is the system which, after very careful consideration, has been adopted by the British Post Office. It is manufactured by the Automatic Electric Company of Chicago and the Automatic Telephone Manufacturing Company of Liverpool. This was the system which the author described in volume i. of this work. In the volume now before us he discusses large "multi-office" automatic systems and semi-automatic working. Practically all the important systems which are in use, or are nearly ready to be brought into use, are described. The work will be of help to experts. Standardisation is still a long way off. On the Continent the rotary system with switches for 500 lines is popular, and in the United States the panel system is widely used. The author discusses the question of metering calls. In the United States, as a rule, with automatic systems, the calls are not registered. This saves time, and the plant is therefore more efficient. In Great Britain, meters have always been considered necessary because of the introduction of the message rate system. More complicated systems of tariff are, however, being proposed, but before being adopted it will be necessary to convince the consumer that they are equitable.

The First Days of Knowledge: as Narrated quite simply for Young Readers. By Frederic Arnold Kummer. (*The Earth's Story*, Vol. 2.) Pp. 314. (London: Hodder and Stoughton, Ltd., 1923.) 7*s.* 6*d.* net.

THIS is the second volume of a series of three called "The Earth's Story," of which the first was "The First Days of Man." In a preface to parents, the author explains that his object is to place before young readers a picture of the growth of civilisation in a form which will appeal to the imagination, stimulate thought, and at the same time link up with previous knowledge. This volume, after two introductory chapters, begins with the discovery of bronze; but in dealing with the growth of civilisation from that point onward the treatment is by subject and not chronological. Certain typical inventions, weaving, the water clock, the discovery of silk, irrigation, writing, and so on, are taken one by one and treated imaginatively and, on the whole, accurately. The chapter on religion might not perhaps pass the strict critic in all its detail, but this is perhaps out of deference to young readers—or their parents. It is, however, a little disconcerting to find Constantinople situated in Asia Minor.

Plane and Solid Geometry. By Prof. Walter Burton Ford and Charles Ammerman. Edited by Earle Raymond Hedrick. (Mathematical Texts Series.) Second revised edition. Pp. xi+356+xxviii. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1923.) 7*s.* 6*d.* net.

THIS is a second edition of a pleasant book. There is nothing very startling in the treatment or sequence, except that the "Pythagorean Theorem" is artificially postponed, apparently so that the authors might give an alternative proof based on proportionals. This is a mistake, because Pythagoras's theorem is the one thing that beginners in geometry get excited about, and its place is as early as is consistent with logical presentation. The alternative proof could have been inserted all the same.

The solid geometry is particularly well done, and the solid diagrams are very realistic. There are numerous applications to practical problems of life and of science, a brief historical sketch, and some useful tables.

S. B.

Cancer Research at the Middlesex Hospital, 1900–1924: Retrospect and Prospect. Compiled by members of the Staff of the Hospital and Medical School and issued by the authority of the Cancer and General Research Committee. Edited by W. Sampson Handley. (Published for the Middlesex Hospital Press.) Pp. ix+90+9 plates. (London: John Murray, 1924.) 3*s.* 6*d.* net.

THIS small work gives an account of the work on cancer at the Middlesex Hospital, particularly from 1910 to 1923, and incidentally since 1792, when Mr. Samuel Whitbread first endowed wards for the reception of cancer patients, who could remain "until relieved by art or released by death." The record is one of general progress at the Middlesex Hospital, and the book seems to be designed for the lay reader instead of the scientific worker. The financial needs of the cancer department are emphasised in a special chapter.

Letters to the Editor.

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

The Physical Nature of Verse.

VERSE as it comes from the speaker consists of currents and vibrations of air in front of the mouth, and of vibrations that are transmitted outward. All that passes from the speaker to the hearer is contained in the air vibrations. The first step in the study of verse must be the purely physical one of registering and analysing the air-vibrations.

The first investigation of this kind was made at Yale University by tracing off a gramophone record of *Cock Robin*. On a gramophone disc the speech vibrations are contained in the sidewise movements of a groove that runs around the surface of the disc. The disc is placed in the apparatus and rotated very slowly. A steel point follows all the movements of the groove. A long lever attached to this point records these movements with a magnification of 300 times on a moving strip of paper. The line on the paper thus gives an immensely magnified image of the air vibrations.

In the speech tracing the lengths of the sounds are measured and expressed in thousandths of a second; this gives the durations of the sounds. In the vowels the long vibrations register low tones, the short vibrations high tones. By measuring the lengths of the vibrations the pitch of the tone in the vowels is obtained. The amplitudes of the vibrations of the vowels are also measured: this gives some indication of the relations of loud and soft. The results for the first three lines are given in the accompanying table. The first line gives the sounds in the ordinary spelling; the second gives the duration of each sound. The third indicates the average pitch, and the fourth the maximum amplitude. The last line gives the impression on the ear.

	Wh	o	k	i	ll	ed	C	o	ck	R	o	b	i	n ?	
Duration in $\frac{1}{1000}$ sec.	10	189	119	154	74	0	53	126	101	74	140	49	56	74	770
Average pitch		333		555	555			238			186		179	179	
Amplitude		4		6	1			5			5		3	2	
Judgment		strong		strong				weak			strong		weak		

	I	,	s	ai	d	th	e	sp	a	rr	ow,
Duration in $\frac{1}{1000}$ sec.	452	210	0	105	81	32	84	291	170	11	294
Average pitch	55 to 250			189			189		189		192
Amplitude	7			5	1	1	2		5	2	6
Judgment	strong			medium			weak		strong		strong

	W	i	th	m	y	b	ow		an	d	a	rr	ow	
Duration in $\frac{1}{1000}$ sec..	108	60	56	74	291	140	490	11	382	120	189	39	331	420
Average pitch	189	476		179	179		143		189	189	194		143	
Amplitude	2	4	1	1	5		4		2		3		6	
Judgment		strong			strong		strong		medium		strong		strong	

The first sound *Wh* is almost inaudible and can scarcely be found in the curve. The second sound *o* begins with small waves, but rises rapidly to an amplitude of 0·4 mm. It has a rather high average pitch of about 333 and is the longest sound in the line. The curve corresponds to the judgment *strong*. The *k* with a duration of 0·119 sec. is the longest consonant in this line, that is, it is also a strong sound. The *i* is still louder and higher than *o* and is almost as long. The *ll*—short and soft as always—has a high pitch, and is therefore strong. We thus find four strong sounds, one after the other. The whole region is justly to be called a raised portion or a hill in the curve of energy.

Then follows a valley. The *C* is short. The vowel *o* has a somewhat long duration and good strength, but falls about an octave in pitch. The following *ck* has a medium length.

The second hill is marked specially by the length and strength of the vowel *o*. The pitch conforms to the melody of the whole sentence, which begins high and then sinks. The last valley contains the short, low and weak vowel *i* and the quite similar *n*. A long pause follows.

The second and third lines are analysed in a similar way. The results show that the verse is to be considered as a flow of speech of varying energy so adjusted that regions of greater energy alternate with regions of less energy. The regions of greater energy are louder, have longer sounds, and are higher in pitch. The curve of energy is approximately as shown in Fig. 1.

The next investigations were of a graphic record of *Somebody said that it couldn't be done*. The analysis showed that a fourth factor of energy is to be added, namely, precision of enunciation. The regions of greater energy show more precise enunciation in contrast with the regions of less energy with negligent enunciation.

In order to express the rhythmical effect of verse we can use a concept familiar in physics. The centre of gravity of a body is a point in which the entire mass of the body can be considered to be concentrated for the purpose of investigation. The centre of gravity is an example of a centroid of forces, a

concept familiar in mechanics, magnetism, electricity, etc.

Applied to verse the centroid will represent the sum of all the factors—intensity, pitch, duration, precision of enunciation—as concentrated in a point. In a varying course of speech energy there will be a series of points, each of which will represent a moment of greatest energy.

The simplest English poetical line consists of a quantity of speech-sound distributed so as to produce

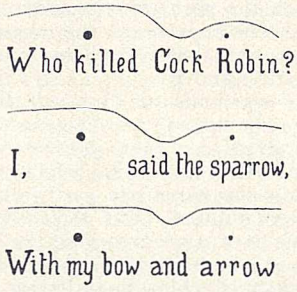

FIG. 1.

an effect equivalent to that of a certain number of points of emphasis at definite intervals. With this view of the nature of English verse all the stanzas of *Cock Robin* can be readily and naturally scanned as having two centroids in each line. The line *Somebody said that it couldn't be done* contains four centroids.

To the speaker and the hearer the flow of verse may be treated in its rhythmic effect as a series of centroids.

A more elaborate study has just been made of the first line of Hamlet's *To be*. The factors contributing to greater energy are found to be: (1) Increased slowness of sound change (longer sounds); (2) increased loudness; (3) raised pitch; (4) increased precision of enunciation. The neighbouring table indicates by + the presence of these factors at the successive phases of the record. The positions of the centroids have been worked out with some precision.

	T o	b e	or	n	o	tt	o	b e	th a	t	i	s	th	e	qu e	s ti	o n
Slowness .		+ +	+ +			+		+	+		+				+ +	+ +	
Loudness .			+		+				+					+		+ +	
Pitch . .			+		+				+					+			
Precision .	+	+		+		+		+		+ –		–	–		+	+ +	
Energy .	Strong			Weak	Strong		Weak	Strong		Weak	Strong		Weak	Strong			Weak

FIG. 2.

The distribution of the current of energy with the positions of the centroids is indicated with some approximation in Fig. 2.

These investigations of verse show that it is purely a matter of rhythm; it has no metre. The usual scheme of prosody with feet, syllables, iambus, trochee, etc., is a fantastic fabric of fancy without the faintest foundation in fact.

E. W. SCRIPTURE.

University of Vienna.

A Possible Origin of Contracted Burials.

No explanation why the people of the palæolithic and many succeeding ages adopted the custom of always burying their dead in the contracted position has yet been universally accepted by archæologists. The reason given by some is that this is the sleeping posture; that the deceased had been thus trussed (by cords which have perished) to prevent his getting up inconveniently to haunt the upper world; or that it was to economise grave-yard ground—of which by the way there could have been then no scarcity, since there were no cemeteries. A larger body of opinion holds that this position was adopted because in being that of the infant during gestation, the dead was being symbolically returned to the womb of Mother-earth. The latter of these suggestions seems to me to credit prehistoric peoples with more knowledge than they were likely to possess; for how many even of our own uninstructed in gynæcology are aware of the embryonic position? Had palæolithic man—who inaugurated the custom—possessed that knowledge, ought he not to have buried his dead in the final posture of gestation—head downwards? Nor have we any authority for believing that the idea of the dead returning to the womb of earth ever at that early period entered his imagination. There occurs to me another possible origin for the custom.

In New Guinea I have seen many natives in sleep and during sickness; they invariably lay—generally on the right side—with their legs drawn up towards the chin; and when ill, close to a warm fire with the hand supporting the head on a wooden or other pillow. It is well known that this attitude affords instinctively the best relief to a sufferer from abdominal or thoracic pain. I witnessed few burials, but I was a close observer of one interesting and touching spectacle. When at anchor in February 1887 in Milne Gulf, a few hundred yards south of Wagawaga, my attention was arrested by the sound of loud and prolonged wailing proceeding from the village. Some hours later a small canoe put off from it heading towards our anchorage, opposite which (I then observed) a grave had been freshly dug a few yards from the strand.

The canoe, containing a figure seated in the bow and another in the stern, was slowly propelled from the stern by a youth wading in the shallow margin of the sea, while a crowd of villagers accompanied it along the shore giving utterance to piercing and woeful cries of *kaione* (adieu). I had a boat lowered and drew in towards the place of interment. As the canoe approached I could see that the figure in the stern was the wailing mother, and that in the bow an elderly man (the father?) who supported between his legs and against his chest the body of a woman (his daughter?) in a closely contracted attitude, her folded arms resting up against her breast. She was nude except for a fine many-tinted petticoat (*kuri-kuri*) such as is used on festive occasions, and a costly nose-pencil.

On the funeral bark reaching the landing spot, the

body was gently lifted out with demonstrations of affection by four men. As they bore it towards the grave, which was more or less circular in shape and some 4½ feet deep, I could clearly see that the cadaver, without any cords or bindings whatever around it, was still held by rigor mortis in the attitude in which it had died. The body was deposited in its last resting-place in this sitting attitude without any unflexing of its limbs. Over it were laid several grass petticoats, but no other grave furniture so far as I observed, before the earth was filled in.

It seems to me not improbable that where among primitive peoples the dead were not retained long above ground after breathing their last, the contracted position, in which Death usually overtook his victims, stiffening limb and muscle in that attitude by the rigor mortis—a rigidity requiring force to abate—came to be adopted as the natural, if not magical, position for sepulture (whether laid on right or left side or set erect) rather than from any idea of the deceased's position when an embryo, or of "his returning to the womb of earth."

HENRY O. FORBES.

Deanway, Beaconsfield, Bucks.

The Choice of Wave-lengths for Achromatism in Telescopes.

DURING the past summer, in the Transactions of the Optical Society, Mr. J. W. Gifford has directed attention anew to the question as to the two wave-lengths most suitable for achromatising telescope objectives. Mr. Gifford has constructed telescopes in which the paraxial focal length for the D and E lines is the same, and, judging by the performance of such objectives, he considers such a choice superior to the more customary choice of the C and F lines. By a different path I have been led to a similar judgment, at least for telescopes of large aperture.

It is the purpose of this note to show that it is possible to meet the objection, which was made in the discussion, to the closeness of the D and E lines, and also to indicate certain relations which exist between the wave-lengths selected for achromatising and the type of achromatisation which results. The results are for a thin contact pair of hard crown and dense flint, and are deduced with the aid of Hartmann's interpolation formula.

The result of making the focal length the same for two different wave-lengths is to make the focal length a minimum for some wave-length intermediate between these two. On the blue side of this minimum the focal length increases more rapidly than it does on the red side, and as the wave-length of the minimum is made greater, the curve which represents the variation in focal length is made noticeably more flat. From two such curves with minimum wave-lengths of 550 and 560 millimicrons respectively, the data which is represented on the accompanying diagram (Fig. 1) was obtained.

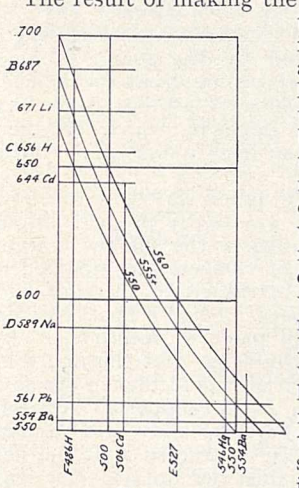

FIG. 1.

On the diagram the curve marked "560" represents all possible choices of wave-lengths which can be used to bring the minimum focal length of the achromatised doublet to a wave-length of 560 μμ. If, for example, one wishes to use the E line and to have the minimum at 560, then one must make the focal length the same for 527 and for 600 μμ. Or, the choice of B and F for achromatising will make the wave-length of minimum focal length just a trifle greater than 560 μμ. In a similar manner, the curve "550" represents all possible choices of wave-lengths which will give that value for the wave-length of the minimum focal length. The intermediate curve, marked "555+," is drawn with the same form as the other two and passes through the point of intersection of D and E. This curve, then, represents the possible combinations of wave-lengths which will be equivalent to the combination of D and E.

Evidently the red lithium line and the F hydrogen line will give very nearly the same result as the combination of D and E, and there does not seem to be any other convenient combination which will so serve. However, hydrogen tubes are easily obtained, and a lithium coloured bunsen flame can be maintained for hours at a time by wrapping around the burner a small square of paper which has been previously soaked in a solution of lithium chloride and then dried, feeding the paper slowly up into the flame as it is burned away.

I may add that the aberrations should be corrected for a wave-length in the neighbourhood of that for which the focal length is a minimum. If the hydrogen tube be contaminated with a little mercury, it will furnish the mercury line at 546 μμ, by means of which a value of the index of refraction could be obtained not differing greatly from that at the minimum.

T. TOWNSEND SMITH.

Brace Laboratory,
University of Nebraska,
September 10.

Lake Victoria and the Flow of the Yala River.

WITH considerable diffidence I venture to offer an explanation of the diurnal current change described by Dr. G. D. Hale Carpenter in NATURE of August 30, p. 311. In equatorial regions a twelve-hourly barometric oscillation attains its maximum amplitude of approximately 0·9 mm. of mercury. The maxima occur daily at about 9.10 A.M. and P.M. Thus, in the absence of major barometric fluctuations, the pressure is on the decrease from about 9 A.M. until early in the afternoon at a time corresponding approximately with the time of reversal of the current. It follows that the lake level will be rising during this period, and hence an overflow into the deltaic marsh. The volume of river water entering the swamp should be sufficient to account for the reversal occurring about one hour previous to the time of the barometric minimum.

A second factor that should augment this effect is differential evaporation between lake and swamp. The shallow water of the latter would probably grow warmer during this period and lose more by evaporation than the deep water of the lake.

Further information as to the behaviour of the current during the night—the time of the diurnal rainfall (if this be regular) and the time thereafter when the river level rises—might materially assist in solving the problem. NORMAN L. SILVESTER.

Aber, Cavendish Ave., Finchley, N.3.

WITH reference to Dr. Hale Carpenter's letter (NATURE, August 30, p. 311) on the subject of Lake Victoria and the flow of the Yala River, the following considerations occur to me. There is a fairly regular diurnal fluctuation in the waters of the lake. At the

head of the Kavirondo Gulf the average level is a few inches higher in the afternoon than in the morning. On the open shore of the lake at Entebbe the variation is naturally smaller, but the figures given by Dr. Carpenter (which appear to be in metres) show a trace of it. I attributed this variation to the alternation of land and lake breezes, which drive the water away from the shore during the night and early morning and towards the shore during the afternoon. From this factor alone one would expect the direction of flow between the Yala swamp and the lake to be from the swamp in the morning and towards it in the afternoon, *i.e.* the reverse of that found by Dr. Carpenter. If the channels between swamp and lake are short and deep, there might be a regular circulation of the water. The diurnal variation of temperature in a shallow swamp is much greater than that in the main body of lake water. The swamp water cooled during the night would flow towards the lake as a bottom current and would be replaced by a surface flow from the lake to the swamp, the latter only being observed by Dr. Carpenter. In the afternoon the heated swamp waters would flow towards the lake as a surface current and the cooler lake water would form the bottom current.

If this solution is not tenable owing to the length or shallowness of the channels, the problem becomes more difficult. Mr. Silvester suggests that the alternation of flow is due to the semi-diurnal wave of pressure. This pressure variation, being approximately equal over both lake and swamp, could not depress one relatively to the other unless there is some factor peculiar to either lake or swamp. The only such factor that occurs to me is the presence of gases such as are usually found in the mud of a swamp. The high pressure and low temperature of the morning would decrease the volume of the gas and lower the level of the swamp waters. During the afternoon the low pressure and high temperature would increase the volume of the gas and raise the level. The production of gas should also be greater during the day, while owing to the vertical circulation, the loss to the air may perhaps be greatest at night. The effect would be aided to some extent by the thermal expansion of the swamp water due to its greater range of temperature. I do not know enough about the volume of gas generated by a tropical swamp to say whether it is sufficient for a reversal of the direction of flow in this manner. Differential evaporation could not solve the problem, as its effect would be, not only very small, but in the wrong direction. C. E. P. BROOKS.

Meteorological Office,
South Kensington, S.W.7,
September 15.

Analytical Sound Records.

THE compound resonators exhibited at the conversazione of the Royal Society in June last have proved useful for obtaining photographic records of music and speech which clearly exhibit their constituent frequencies. Fig. 1 is a record of a scale

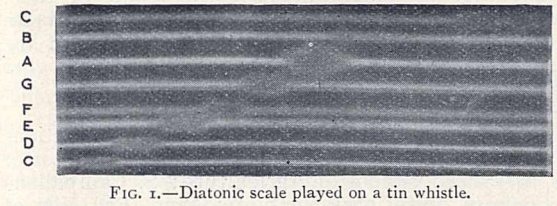

FIG. 1.—Diatonic scale played on a tin whistle.

played on an ordinary tin whistle, which, contrary to popular opinion, is known to produce nearly pure notes free from overtones. It will be noticed (1) that there is no overlapping of the notes, each note, when sounding, leaving all the resonators undisturbed except the particular resonator tuned to it. This applies even where the interval is only a semitone; (2) the sounding of a note does not affect the resonator an octave below or above. This observation settles a point in resonance concerning which, I believe, there has been some doubt hitherto.

Fig. 2 shows a record obtained by playing an air

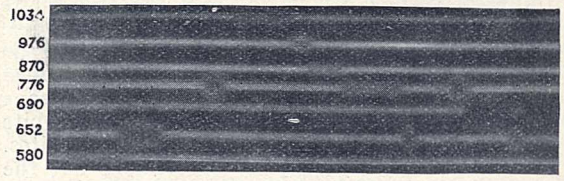

FIG. 2.—"There's no place like home" played on a tin whistle: seven resonators covering the diatonic scale.

on the whistle. It will be seen that the response of the various resonators is very quick, requiring not more than 0·05 sec. for its full establishment. The slight longitudinal overlapping observed in some notes is merely an effect due to the fact that the patches producing the lines are elongated in the direction of the lines themselves, in order to increase the illumination. The high damping factor of the mica reeds produces an equally instantaneous cessation of the note picture when the note ceases to sound. It will, therefore, probably be found possible to record even demi-semi-quavers by this method. An attempt to record a rather fast piece of music is shown in Fig. 3.

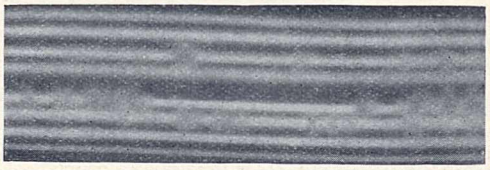

FIG. 3.—Photographic record of a passage from "The Gondoliers" (Gilbert and Sullivan) using eight resonators.

I have, so far, constructed efficient resonators of this kind extending over four octaves. It is obvious that if the method can be made to cover the whole range of musical sounds, a very rapid and convenient method of sound analysis will be at our disposal.

E. E. FOURNIER D'ALBE.

Westergate House,
Kingston-on-Thames.

Mendelism and Evolution.

As a member of the British Association who had the privilege, by the generous hospitality of Mr. Richard Marsh, of seeing the white and brown Indians from Panama at Mr. Marsh's temporary residence near Prescott, Ontario, I should like to comment briefly on Mr. Julian Huxley's letter on the subject in NATURE of September 27. It seems to me that there is some degree of inconsistency in Mr. Huxley's remarks. He states that all authorities are agreed that the condition of the white Indians has no racial significance, and yet finally concludes that the case shows how evolutionary change may originate in single mutations of considerable magnitude. I suppose that the phrase "has no racial significance" means that the difference between white and brown Indians is not in any sense or degree similar to the differences between the various races of mankind. It would follow, therefore, that however interesting and important the white mutation may be, it does *not* show that the evolution of human races has had anything to do with mutations of this kind.

It is true that blue eyes are found to be a simple recessive, and many human abnormalities are

known which behave as single Mendelian characters. The distinguishing peculiarity of the white Panama Indians is chiefly, but apparently not entirely, a pigment character. But I believe that there is no human race whose pigment character behaves in crosses with other races as a simple Mendelian recessive; and I believe there is no human race which is distinguished from other races by pigmentation alone. Prof. Karl Pearson has maintained that the white European originated as an albino from a dark race. But it seems proved that the white character of the European does not segregate completely in crosses with other races, and therefore does not behave as albinism. Mr. Huxley states that the white Indians mate almost wholly with other whites. There is a certain amount of separation, but the white girl among the group which Mr. Marsh has with him is the daughter of parents who are both normal brown individuals, and who are both with her. Each of these parents had one white parent.

I hope to give further study to the matter, but so far it seems to me that this case tends to demonstrate the difference rather than the similarity between mutation and evolution. J. T. CUNNINGHAM.

October 1.

The Indian Institute of Science, Bangalore.

IT is a matter of sincere pleasure to those who are students of science in India to read in NATURE of August 2 an account by Dr. Morris W. Travers of the early working and the history of the Indian Institute of Science.

All those who have seen this splendid Institute have a word of praise and admiration for Dr. Travers, who equipped it so that it continues to be one of the finest laboratories in the British Empire. The libraries attached to this Institute are second to none in the world.

That these laboratories will turn out scientific work of the highest importance is only a question of time. With increasing consciousness of the importance of research in India, and the enlarged reforms which give Indians greater scope for intellectual and political activities, the Institute is sure, in time, to fulfil the hopes which its equipment inspires.

When the political status of India is that of a free Dominion in the British Empire, the British names which will be written in golden letters for bringing about that happy state of affairs will not be those of statesmen only, but will include also prominent chemists such as Crum Brown for giving us Sir P. C. Rây, the founder of a school of chemical research in India, Donnan and Thorpe for inspiring the largest number of physical and organic chemists in India, and above all Travers, for building the Indian Institute of Science at Bangalore. S. S. BHATNAGAR

(Director of University Chemical Laboratories, The Panjab University, Lahore; and Hon. University Professor of Chemistry, Benares Hindu University).

Benares, September 9.

Gravity Measurements in Deep Water.

ATTEMPTS at determining the gravity force over the oceans do not seem to have met with unqualified success. The following suggestion, so far as I know, is new. Possibly some objection to its use may exist.

A pendulum of the usual type is suspended within a steel vessel of sufficient strength and lowered on a sounding wire to the bottom of the ocean. The verticality of the steel vessel is secured by suspending it from a tripod which takes up a stable position on the sea-floor.

Vanes attached externally to the steel vessel keep it from taking up a vibratory motion, and a surrounding screen protects it from possible currents. Within the vessel there is a photo-electric cell; a small dry-battery and lamp; and a simple electromagnetic arrangement for the release of the pendulum, which, while being lowered, is held by this release in a deflected position. A recording thermometer is also contained within the vessel. A single insulated wire makes connexion with the ship.

When the pendulum has been for some time at the bottom, so as to take up a constant temperature, and to allow for initial settlement, it is released by a momentary current from the ship. It now falls into vibration, and at each vibration screens the photo-electric cell from the lamp. The periodically interrupted current so created reaches the ship through the connecting wire.

It is desirable to compare these vibrations with the vibrations of a standard pendulum upon the land. This is accomplished by means of wireless. The current from the submerged apparatus, after reinforcement, operates the wireless of the ship, and so is transmitted to a station on the land. Or, alternatively, the vibrations of a shore pendulum are transmitted to the ship and the comparison carried out on board. J. JOLY.

Trinity College, Dublin,
September 12.

The Institute of Catalan Studies at Barcelona.

IN June last, Prof. Dwelshauvers, the Belgian philosopher, was dismissed by the Spanish Directorate from his position of director of the Laboratory of Experimental Psychology at Barcelona. The reasons given for his dismissal were that his researches were frivolous, and that as the results were only published in a foreign periodical, *L'Année psychologique*, the work must stop on grounds of economy.

The Laboratory was under the patronage of the Institute of Catalan Studies, against which a general attack has been made by the Spanish Government on the ground that its tendency is separatist and subversive. Public opinion in Barcelona hotly resented the action against Prof. Dwelshauvers, and one hundred and twenty-five professors and science teachers signed a letter of sympathy and protest, which was published in the daily press.

The Directorate professed to consider this letter an insult to the military government, and it was announced that unless an apology was publicly made by the signatories they would be dismissed from their posts. The professors replied that their action was dictated by sympathy with a colleague and had no political significance, and that therefore they had nothing to withdraw. In consequence they have all been dismissed.

Only those who know the work of the Institute of Catalan Studies can appreciate the result of this: practically all the higher education of the Catalan provinces has ceased, for, with the exception of the Castillian University in Barcelona, the whole higher and technical education was in the hands of the Institute.

Among those dismissed are several with reputations outside Spain, including S. Pi i Suñer, Director of the Advanced School of Agriculture; S. Campallans of Louvain and Charlottenburg; Prof. Pau Vila of Geneva and Grenoble; and Prof. Pompeu Fabra, the well-known philologist and the virtual creator of modern literary Catalan.

JOHN LANGDON-DAVIES.

Geology and Evolution.[1]

By Prof. W. W. WATTS, F.R.S.

WHILE astronomy has given us the conception of illimitable space, it has done much to destroy what has been called the anthropomorphic view of creation. Geology, on the other hand, has endowed us with an almost limitless conception of time, but has done something to rehabilitate the importance of man as the highest product yet reached in the long history of the earth.

This it has done, in the main, through the intense reality that it has given to the conception of evolution. Although several authors, and two in particular, have pointed out that such a conception could not have been formed without the postulates of time and continuity of existence contributed by geology, it is scarcely realised how much geological labour on the life of the earth, and on life on the earth, as summed up by Lyell and grouped and presented by him in his great work on "The Principles of Geology," was necessary to give to evolution a concrete and cogent application. The function of this labour could scarcely be better indicated than by the position of geology as displayed in Lyell's earlier editions. The modern reader of them is continually haunted by the feeling that the author was feeling and struggling for a single missing generalisation which he failed to find; and although, in almost every branch of the subject treated, Lyell leads up again and again to the missing conception, and though the facts and inferences which he marshalled can now be seen to be marching on this great idea, he never quite succeeded in attaining it for himself. It was left for Darwin, than whom no one was more conscious of what he owed to Lyell, to see that the facts must rest on some great single fundamental principle, to realise that this principle was evolution, and to apply it to his own branch, the development of life.

Lyell had proved that the long history of the earth as recorded in the rocks revealed the operation of causes, small in relation to the earth as a whole, but persistent, the majority of them still in action. It was a further debt to Lyell that Darwin should bring in the continuous operation of small causes as the machinery operating and guiding the evolution of life.

Though the work of geologists, as summed up in Lyell, provided the starting-point for the conception of organic evolution, it did not stop here. The idea of Uniformitarianism in which that work culminated was meant as a reaction against the fantastic operations postulated by the Catastrophists, and was never intended to imply that these causes in the past were always balanced or distributed as they now are. There was in Lyell's statements nothing to indicate that denudation or earth-movement might not have been more active at periods of the past, that organic change might not accelerate or slow down, that there might not be variations in the trends of continental or oceanic development resulting in climatal and other changes, or that the very sources and intensities of energy from outside or inside the earth might not seriously vary. Only, warrant must be found for all such suppositions with regard to the earth of the past from fuller study of the earth of the present. If we recognise the inner spirit which inspired the eloquent words of Lyell, when he had grasped that Darwin had supplied the one missing idea, we cannot fail to see that his Uniformitarianism included evolution as one of the "existing causes" to be taken into consideration.

The physiology of the earth, however, is that of a very complex organism, and we are sure that we do not yet know all the forces internal and external acting upon it, still less their relative value and intensity, their distribution and variation in the past, or the precise records which each is capable of imprinting on the rocks of the earth-crust. It is becoming clearer that there has been a periodicity in the stages of development of the earth-crust, and that on these great pulses of earth-life there have been imposed innumerable waves of smaller cycles; and that, on account of their interference with, or reinforcement of, one another, the simpler type of cyclic repetition which might have been looked for in the history is masked and broken and diversified by actual happenings of an infinite variety. Van Hise more than once complained of the tendency of geologists to adhere to single explanations of events, and advocated the necessity of considering the co-operation of many causes; and it may well be that in many outstanding problems such as past glacial or tropical periods, coral reefs, stages of earth movement, progression and regression of the oceans, we may find the ultimate explanation in the interaction of a number of "true causes."

During the long period of time comprised in the history from the Cambrian Period onwards, the slow and persistent evolution of plant and animal life went forward and left ample record in the rocks. To warrant a belief in organic evolution, we are no longer solely dependent on reasoning founded on existing organisms or on the facts of their ontogeny and distribution. As M. Marcellin Boule says in his work on fossil man, ". . . pour tout ce qui a trait à l'évolution des êtres organisés en général, le dernier mot doit rester à la Paléontologie quand cette science est en mesure de parler clairement. Les plus fins travaux anatomiques, les comparaisons les plus approfondies, les raisonnements les plus ingénieux sur la morphologie des êtres actuels ne sauraient avoir la valeur démonstrative des documents tirés de la roche où ils sont enfouis et disposés dans leur ordre chronologique même."[2] Although we are only too painfully aware of the innumerable chances that conspire to prevent an animal or plant from securing immortality by preservation as a fossil, the finding of better-preserved material, the more skilful preparation of it for examination, and the application to it of refined biological methods, such as careful dissection and the serial sections of Prof. Sollas, are giving us more complete and accurate knowledge than ever before. It may now be confidently stated that many of the most crucial links in the chain of evolving life are in our hands, that they actually lived in the past, and that their fossil forms show their

[1] From the presidential address, "Geology in the Service of Man," delivered to Section C (Geology) of the British Association at Toronto on August 8.

[2] Marcellin Boule, "Les Hommes fossiles," p. 453

relationship to their predecessors and successors. The time has come when Darwin's famous chapter on the "Imperfection of the Geological Record," an apology written with the most balanced criticism and unbiassed judgment, should be re-written and revised.

It is true that we seem as far as ever from unveiling the points of divergence of the great phyla, and we can but feel that the time from the beginning of the Cambrian Period onward is but a small part of the whole history of life on the earth. As with antiquarian research, each new discovery in geology, whether on the physical or the biological side, only brings these distant ages more fully into view and emphasises their modernity and their likeness to our own time. Hutton's famous dictum that he saw "no vestige of a beginning, no prospect of an end," is to-day more true than ever, when we regard the evidence of stratified rocks. But we know enough to convince us that within post-Cambrian time evolution has steadily proceeded from general to special, from simple to complex, from lower to higher efficiency.

In almost every subdivision of the animal kingdom, and in not a few branches of the vegetable kingdom, lines of descent and directions of specialisation have been made out, sometimes visibly operating throughout whole systems, but more usually through smaller divisions of the record; and this in the former kingdom not only among vertebrates but also among the invertebrates and even their lower sub-kingdoms. It may even be stated that in methods of defence, in food procuring, in the attainment of favourable positions and attitudes, something very closely imitating what would be expected on the doctrine of the origin of species by "survival of the fittest" has again and again occurred.

The essence of evolution is unbroken sequence, and when we consider the extraordinary delicacy of the adjustment of life to its physical and organic environment, the mutual interdependence of life forms, and the necessity to them of such factors as favourable range of temperature, food, climatic conditions, soil, and the continuity of the "element" in or on which they live, it is most wonderful that in the vast lapse of post-Archæan time it has been possible for life to exist continuously, and continually to evolve, throughout those long ages. And this in spite of the fact that, although the main chain has been unbroken, conditions have, in many cases, been so unfavourable that whole groups have flourished and died out, while others have become so attenuated that only a few survivors have been left, highly restricted in distribution, to burgeon out again when the unfavourable conditions were removed, or in other places where conditions have again become more favourable to them.

That life has survived continuously in spite of the vicissitudes through which it has been compelled to pass, and the frequent convergence upon it of unfavourable conditions, may well be taken to heart by those who fear that civilisation will be brought to an end by the misuse of the powers that itself has evolved. They may surely take courage and trust that the remedy for these evils will come, as it has in innumerable other cases, not from conventions and understandings that, as all history shows, will be mere scraps of paper, but from the intensive application to them of the very science which has evolved them.

Although the geological record is and possibly will always remain incomplete, it has yet proved remarkably representative, and certain outstanding facts have been made out which are sufficient to show that the lines of organic evolution as recorded in geology are in accordance with what is theoretically probable, and with those taken by the evolution of domesticated organisms and by human arts and inventions.

(1) There can be no doubt that the stages of organic evolution are correlated with, and were actuated by, the stages in the inorganic evolution of the earth itself; that climatic change was effective in inducing migration, and thus in sharpening the struggle for existence against both enemy organisms and changed physical environment; that extension and restriction of land and water areas in some cases brought about keener and more varied competition, change of habit or food, and in others the destruction of potential enemies and the securing of the advantages of a fair field for the survivors; and that activity of the earth-crust in such things as deposition and mountain building provided conditions for the existence of an increased range of varieties and the consequent struggle between them. If we are not allowed to say that this brought about the survival of the fit, it at least caused the destruction of the unfit.

(2) It may be stated as a biological law that every locality becomes "full" of life, forms arriving or evolving to take advantage of the special facilities offered. In consequence, resistance to the incursion of new forms, even if they are exceptionally equipped, is very great, and it is only occasionally that such new forms can make good their immigration. There are, of course, marked exceptions, but these generally occur when degeneration or overgrowth in size accompanied by neglect of means of defence has occurred, or when an area has been for so long sheltered from the wider and more general course of evolution that it has fallen seriously behindhand in the race.

The geological record gives indirect evidence of the same "filling" of areas in the past in the extraordinary slowness with which advanced types, that have eventually made great headway, established themselves after their introduction; the earliest fishes, reptiles, and mammals are cases in point. Imperfect as the first members of these groups undoubtedly were, they must, even shortly after their introduction, have possessed considerable advantages over the older and established forms with which they found themselves in competition. In size and strength they were doubtless inferior, and probably they must have taken long periods to make good their advantage. But in all such cases the new forms went for a long period into "retreat," and in face of the apparent slowness of their evolution and the bitter competition to which they were subjected, it is remarkable that they overpassed the troubles of racial youth, and eventually took the place to which they were entitled in the scheme of life. It seems justifiable to believe that there must have been at least some well-equipped types which did not survive competition in these early stages, but went under with all their promise of future success. We can easily imagine that the survival of such, had it

occurred, may have altered the whole course of evolution and produced a life story very different from that we know to-day, and of which we ourselves form no small part.

(3) Not less remarkable than the period of "retreat" is that of booming development which at last came to each successful modification. In this connexion we can instance the *pleine évolution* of the graptolites, the euechinoids, ammonoids, and belemnoids, the fishes, reptiles, birds, and mammals, each in its own time. Each slowly but surely built up its supremacy, and then wantoned through long ages as the lord of creation in its own element and in its own day. Both the period of sanctuary and the subsequent boom can be closely paralleled by the case of many human inventions and in the occupations and history of mankind.

(4) While there are outstanding cases in which a line of advance is taken that is capable of successive improvements and leads on to continuous success, there are many others in which the line of advance, though temporarily advantageous, has only been carried through a limited number of stages. Eventually it has failed either by its inherent inadequacy or by imposing so heavy a burden on the economy of the organism that it was unable to bear the cost.

The only example I need quote, though there are many others, is the use of defensive armour, spines, plates, hooks, horns, etc. These provide an obvious method of resistance to attack, and this defensive attitude has been practised by one group of organisms after another, but always with the same disastrous result, the imposition of a fatal strain on the organism to meet renewed, perfected, and more vigorous attack. The spinose graptolites and trilobites, the armoured fishes and reptiles, are cases in point, and in the last of these examples, at least, victory rested with the acquirement of swiftness in movement, accompanied by increasing power of attack such as is given by the development of teeth or claws or both. Again and again in the Tertiary era one group of mammals after another, before, or more usually after, the attainment of great size, has taken to some means of sedentary defence, and in every case the cost of upkeep has been too great and the group has gone under. Every time the race has been to the swift, active, and strong, and those that trusted in "passive resistance," in "defence and not defiance," have gone under in competition with those that have been prepared to face the risks involved in attack. The fact that turtles and armadilloes have survived to the present endorses rather than vitiates the principle.

Other cases of rapid decline or sudden disappearance are more difficult to account for. The waning of the brachiopods but yet not their disappearance, the disappearance of the pteridosperms, the rugose corals, the belemnoids and ammonoids synchronising with the vanishing of many orders of reptiles, will long furnish subjects for research by biologists and geologists. It may well be that the explanation will often lie along biological rather than physical lines, such as those suggested for the graptolites; Lapworth pointed out that their disappearance—in spite of a brave effort of passive resistance—synchronised with the great development of fishes, and the assumption by them of many of the functions previously discharged by the trilobites. In other cases the explanation may be more in the direction of that given for the reptiles to be referred to later.

The rarity in the geological record of some of the stages in evolution, and the absence of others which must surely have existed, may receive some explanation from what has frequently occurred in the history of human invention. If variants arise and are subjected to intense competition, they have no chance in the struggle for existence unless they show rapid improvement and development of the favourable variations within a few generations. Hence the numbers exhibiting each of the early stages of change will always be few and the chances of their preservation slight. Those who have tried to work out the stages in the history of an invention, for example, will appreciate the rarity of "missing links" and the difficulty of filling in every step towards the later perfection. These are looked upon as "freaks" and, unless they present real and marked improvement, are never manufactured on a large scale. Their numbers consequently are few, and many of them are the victims of experiment and often do not survive the experience.

(5) Perhaps the most wonderful result disclosed by a study of the later part of the geological record is the steady and unbroken evolution of brain from the earliest vertebrate animals to the present. The exceeding slowness of the process in its early stages is not less wonderful than its acceleration during the latest stages of geological history. The disappearance of so many orders of reptiles at the end of the Mesozoic Period, at the close of a long and most promising chain of evolution, indicates that there was some inherent weakness underlying the line of evolution entered upon by them, which proceeded so far and favourably that it was impossible to retrace the path. This may well have been connected with the substance or construction of brain and nerve. If so, this side of evolution has to be seriously reckoned with, and it may be that the fundamental weakness of physical as opposed to intellectual evolution brought this flourishing and well-developed group to its end.

It has, of course, been suggested by Starkie Gardiner and others that the destruction of Mesozoic life types was brought about by physical changes; but, apart from the fact that the particular changes supposed by the former did not as a matter of fact occur, the entire explanation provides a cause utterly insufficient in comparison with the potency of organic struggle against creatures better endowed with warm blood, adequate brain substance, and the activity and enterprise springing therefrom.

In spite of the evidence of acceleration as the higher ranks of animals are reached, and in spite of the extraordinary efficiency of the human brain and all the benefits to the organism it brings about, we may well be appalled by the æons which have been used up and the millions of varieties which have passed away in the production of this, the most efficient scientific apparatus yet invented or evolved.

(6) If, however, it has taken long ages to evolve an animal capable of a broader geographical distribution than any other, with a constitution capable of withstanding the widest ranges of heat and cold, and of peopling the world from its tropical deserts to its polar

wastes; and to endow him with a brain by virtue of which he has made himself master of the earth and all its living inhabitants; it has taken no less time for the evolution of the many factors without which his present success would have been impossible. To pick out a single instance, probably few things in the whole story of life have been more fruitful in effect than the appearance of the grasses in late Eocene times, followed by their rapid evolution and spread in the Oligocene and under the direction of the critical events of the Miocene Period. Starkie Gardiner in an admirable paper first directed attention to the vital importance to the animal evolution of the world in general, and to the welfare of man in particular, of this step forward. It was followed by great changes in the insect world, by the rapid production of herbivorous mammals endowed with speed, great migratory powers, special dental and other anatomical adjustment to the new foods, and the institution in their herds of a discipline, subordination, and leadership which are almost tribal. These last qualities were rendered doubly necessary by the consequent rapid development of carnivora, and the need for "scrapping" passive and even active means of defence in order to secure the power, speed, and reserve necessary to follow their food harvests over great stretches of country. At the same time the habits and instincts thus brought about were those which man, by domestication, has been able to turn to his own ends. Thus at a blow, as the outcome of this stage of Tertiary evolution, there became available for mankind not only his chief plant food and drink, his luxuries as well as his necessaries, but also his chief animal foods, together with his aid from the speed, strength, service, and endurance of the animals which he domesticated, and to which he assumed the position of leader to the herd.

While with the aid just described it was possible for mankind to progress far on the road of civilisation, progress would have been stopped, and as a matter of fact was seriously retarded, until the discovery and utilisation of the solar energy stored up in the earth's crust during the Carboniferous and subsequent periods in the form of coal and other fossil fuels. The very exceptional conditions, climatal, geographical, and botanical, requisite for coal formation, occurred all too seldom in geological history, but it has so happened that few areas of the earth are devoid of coal belonging to one period or another; and the shaping of kingdoms and dominions has been such as to include supplies of fuel in most of them. Whatever may be the main sources of energy in the future, radiant, intratelluric, hydraulic, tidal, atomic, we have been largely dependent in the past, and probably shall continue to depend for many years to come, on that portion of the solar energy stored up by vegetation, and especially on that preserved in the earth-crust in the form of coal.

Again civilisation must have been greatly hampered or driven into a different course but for the agencies which have sorted out from the medley of materials of which the earth is composed, simple compounds or aggregates of compounds, or in rarer cases simple elements, in such a form that they are available for human use without the expenditure on them of excessive quantities of energy. The concentration of metalliferous ores, salines, and the host of other mineral resources has made perhaps the most important contribution of all to the latest stage—in good and evil—attained by civilisation.

Finally, doubt may be expressed whether man could have attained his present position if he had not made his appearance comparatively soon after a period of intense earth activity, when broad areas of newly raised sediment were available for occupation, when the agents of denudation and renewal were in active operation, and when a wave of rapid organic evolution was active. A conjecture may also be permitted that human evolution itself was probably hastened by the latest climatal severity through which the earth passed, the effects of which are only slowly passing away.

Much of what has just been said may revive recollection of an old Swiss guide-book which praised the beneficence of Providence in directing the dreaded avalanches "into the desolate and uninhabited valley of the Trumleten Thal and in sheltering from them the beautiful, fertile, and inhabited valley of Lauterbrunnen." However, it is far from my intention to imply that "everything is for the best in this best of all possible worlds," but only to point out, in reviewing the long chain of events of which we see the present end-product in civilised man, that within the ken of the geologist there have been many critical stages in the earth's history when any marked change in the conditions which then prevailed must inevitably have reacted profoundly upon the development of the human race when at long last it stepped out from the lower ranks to take the earth as its rightful possession.

In the course of the development of both the economic and the scientific sides of geology, the principles discovered and elaborated have fertilised and enriched human thought as expressed not only in other sciences but also in the sphere of literature. As it has become more precise and is able to give a more accurate and detailed picture of the stages through which the earth passed during the long story unfolded by the study of the stratified rocks, it has shown that the earth, though only a minute fraction of the visible universe, has had a wonderful and individual history of its own. The keynote of this history is evolution, the dream of philosophers from the earliest times, now passed from the realm of hypothesis into that of established theory.

We are able to watch the evolution of the oceans and continents, of the distribution of landscape and climates, and of the long succession of living beings on the earth, throughout many millions of years. During these ages we see the action of the same chemical and physical laws as are now in operation, modified perhaps in scale or scope, producing geographical and biological results comparable with those of to-day. Hutton and Lyell discovered for us in the present a key to unlock the secrets of the past; the history thus revealed illuminates and explains many of the phenomena of the present. The outcome of it all is to endow man with a simple and worthy conception of the story of creation, and to fill him with reverence for the wondrous scheme which, unrolling through the ages, without haste, without rest, has prepared the world for man's dominion and made him fit and able to occupy it.

Liquid Air in Mine Rescue Apparatus.

THE Mines Rescue Apparatus Research Committee which was appointed by the Advisory Council for Scientific and Industrial Research to inquire into the types of breathing apparatus used in coal mines, and to determine experimentally the advantages, limitations, and defects of the several types, has recently presented its third and final Report.[1] In the first report, attention was directed to certain serious defects in rescue apparatus, and to the training of rescue brigades; and the lines along which improvement in design was necessary were indicated. In the second report, methods of testing compressed oxygen apparatus were proposed and descriptions of new and improved appliances were given. The third report deals principally with the use of liquid air and liquid oxygen in mine rescue apparatus, and will prove of interest not only to mining engineers but also to all who have occasion to use liquid air and oxygen.

The report includes, in addition to a detailed description of the new Brown-Mills aerophor rescue apparatus, an exhaustive treatment of the problem of the construction of vacuum storage vessels or containers for liquid air.

Liquid air was first used for mine rescue work in an apparatus known as "Aerolith," designed by an Austrian engineer, Herr Lüss, in 1906. This apparatus, which was not provided with a purifier or regenerator for absorbing the carbon dioxide in the exhaled air, failed to supply an adequate amount of air to the wearer when a heavy task was being performed, and consequently its use was strictly limited. In 1910 Col. Blackett invented a regenerative liquid-air apparatus bearing the name of "aerophor"; and it is this type of appliance in a modified and much improved form that has been installed recently in the Northumberland and Durham rescue stations.

The mode of action of the Brown-Mills aerophor, which is the most efficient and trustworthy of this type, will readily be understood by reference to Fig. 1, which is reproduced from the Report. It consists essentially of a "pack" P or liquid-air container, a regenerator or purifier Q, a breathing-bag M, and the necessary metallic and flexible tubes for conveying the gas from the "pack" to the bag and mouthpiece, and the exhaled air from the mouthpiece to the purifier. Liquid air is poured into the pack through a single central opening, and is absorbed by the calcined asbestos wool WW which is packed tightly in a perforated nickel silver case. The air space C which surrounds this case serves to distribute the liquid during the process of charging, and to collect the evaporated air. The latter passes through a pipe G into the space E, which is loosely packed with asbestos. From the upper side of E the gas flows into a metal warming-pipe H, and thence through the tubular collar A to the breathing-bag. During inhalation, air is drawn both from the bag and the purifier through the valve V_1. The exhaled air passes through the valve V_2 to the purifier Q, where the carbon dioxide is removed by caustic soda, and thence through valves V_3 and V_1 back to the mouthpiece. The space E, in addition to serving as an outlet for the evaporated air, impedes and to a limited degree regulates the flow of heat into the interior of the pack, and consequently controls the rate of evaporation. Immediately after charging the pack, the volume of cold air circulating in E, owing to the low specific heat of the liquid air, is very considerable, and consequently its insulating effect is a maximum. This results, at this stage, in a reduction in the amount of heat entering the inner chamber of the pack, and in a tendency to effect a diminution in the ebullition of gas, while towards the end of a "run," when the evaporation is flagging, it is stimulated by an increase in the amount of heat across that space. In spite of this automatic means of regulation the discharge is variable, being approximately 30 litres per minute just after charging, and falling off to 8 litres per minute at the end of the two hours' period. An important feature of the appliance is the valve V_3, which prevents the excess of air delivered from the pack during the first part of a run flowing in a reversed direction through the purifier, and thereby rendering the caustic soda comparatively inert by cooling. The pressure of the air in the breathing circuit is controlled by the relief valve R, which is set to operate at a pressure of about 18 lb. per square foot. The total weight of the apparatus, including the approved charge of 5½ lb. of liquid air and 2 lb. of absorbent, is about 40 lb.

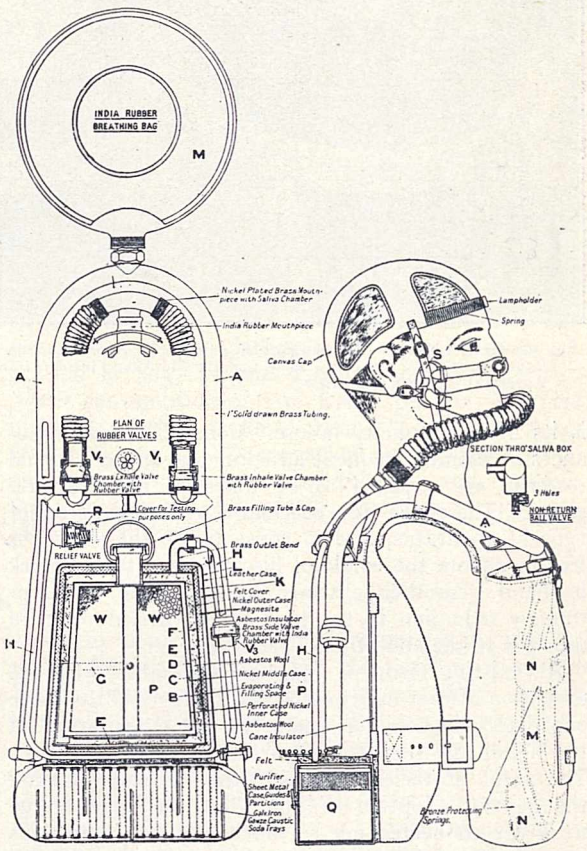

FIG. 1.—Brown and Mills aerophor. Reproduced, by permission of the Controller of H.M. Stationery Office, from the Third and Final Report of the Mine Rescue Apparatus Research Committee.

[1] Department of Scientific and Industrial Research: Advisory Council. Third and Final Report of the Mine Rescue Apparatus Research Committee. Pp. vi+32. (London: H.M. Stationery Office, 1924.) 1s. net.

The chief advantage claimed for the aerophor, and one that is recognised by the Research Committee, is its great simplicity in use. Compressed air appliances necessitate frequent adjustments, and occasional readings are required to be taken of the pressure-gauge. These are not necessary with the aerophor type of apparatus, and in consequence the wearer is free to devote the whole of his attention to the work in hand. Another obvious advantage is the continuous reduction in the load to be carried when in use, due to the ebullition of the charge.

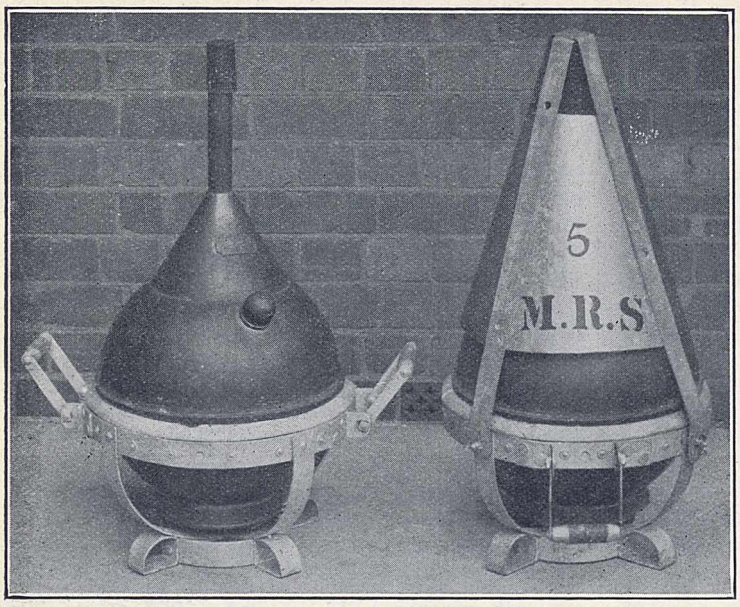

FIG. 2.—Steel cradles for the transport of containers. Reproduced, by permission of the Controller of H.M. Stationery Office, from the Third and Final Report of the Mine Rescue Apparatus Research Committee.

All existing forms of liquid-air apparatus, with the exception of that designed by Mr. G. A. Griffiths, have one defect in common, namely, the evaporation of the liquid air when the apparatus is not being used. The chief obstacles, however, that militate against the general adoption of liquid air for mine rescue work are connected not so much with the apparatus as with the manufacture, storage, and transport of the liquid. As pointed out in the Report, the manufacturing plant, which is costly, requires skilled attention, and has to be run at intervals to make good the loss by evaporation in the reserve of liquid kept in storage flasks. These flasks, although giving little trouble during normal use at the rescue stations, are so delicately constructed that they require very careful handling when being transported at the surface or underground.

The movements of the flasks during a rail or road journey must of necessity increase the rate of evaporation of the liquid air. Experiments, including those which have been carried out under the auspices of the Research Committee by Dr. Briggs and Mr. G. L. Brown, show that under ordinary conditions the loss by evaporation during transport is nearly twice the loss that occurs when the flasks are stationary. With the view of determining the most efficient means of supporting liquid air flasks during transport, two flasks, each containing 50 lb. of air, were carried in a heavy motor ambulance for a distance of 7·6 miles over good roads. The first container, which was placed on the floor of the car, lost 7 oz., whilst the second vessel, which was provided with trunnions carried in spring-mounted bearings, lost 14 oz. This unexpected result was due to the violent swinging of the vessel on its trunnions by the movement of the car, causing rapid ebullition of the air and frequent spurting of the liquid from the neck. As a result of this test the gimbal method of support has been entirely superseded by the simple steel cradle (Fig. 2), a form of stand which is giving remarkably efficient service. Storage flasks or containers form so essential a part of the equipment of liquid-air rescue stations that the Mines Rescue Research Committee is perfectly justified in devoting considerable space to them in its final Report.

The liquid air containers (Fig. 3) are similar in every respect to a "thermos" flask, except that they are made of brass or copper instead of glass, and that a small quantity of specially prepared charcoal is inserted in the vacuum space between the inner and outer vessels. Both vessels are constructed of two hemispherical pressings, joined together by a soft solder, the two necks C and D being soldered to a plug E of solid drawn brass. A conical collar is fixed

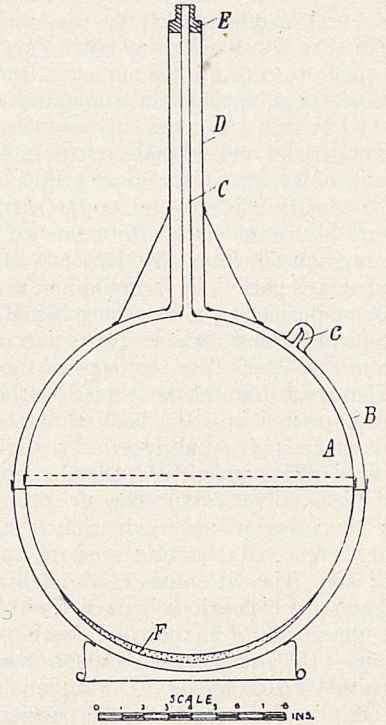

FIG. 3.—German 50-lb. liquid air container. Reproduced, by permission of the Controller of H.M. Stationery Office, from the Third and Final Report of the Mine Rescue Apparatus Research Committee.

around the base of the neck for additional support. The air from the vacuum space is extracted through a lead tube G of about ¼-in. bore. When evacuation is complete this lead is pressed flat, and is then burned off with a small Bunsen flame. The lead seal is protected by a cup-shaped cap filled with wax or bitumen. The surfaces of the globes which face each other across the vacuum space are very highly polished to reduce the transmission of heat by radiation to the liquid air.

The charcoal maintains the vacuum by absorbing the gas that leaks into the vacuous envelope through the porous metals. The remarkable absorptive power of charcoal at low temperatures, discovered by Sir James Dewar in 1905, has made possible the use of metallic vacuum flasks and is contributing most to the rapid expansion that is now taking place in the application of liquid air and oxygen for industrial and scientific purposes. Major Lambert found from experiments he carried out for the Oxygen Research Committee that British palm-nut charcoal was capable of abstracting the residual air from a vessel, which had previously been partially exhausted, to such an extent as to reduce the pressure from 0·0575 mm. to 0·000005 mm.

If it be assumed that the pressure-reduction factor—initial pressure/final pressure—is directly proportional to the amount of adsorbent used, then with the usual charge of 200 gm. of charcoal in a 50 lb. metal container, an initial pressure of 0·1 mm. in the vacuum space will be reduced to a final pressure approaching 0·000002 mm., at the temperature of liquid air. At this exceedingly low pressure the loss of heat by conduction across the vacuum space is negligible in comparison with the loss by radiation. For this reason it is not necessary to reduce the pressure in the envelope of a Dewar metal flask to the very low value required with the glass flask in the preliminary operation of pumping.

In order to determine the decay of the vacua of Dewar metal flasks, Dr. Briggs, a member of the Research Committee, has conducted a series of valuable experiments on 3-litre flasks. The apparatus used enabled the outer wall of a vessel to be punctured, the pressure inside the envelope to be measured, and the puncture sealed without damaging the flask or destroying the vacuum. These experiments showed the average rate of decay of the vacuum to be about 0·011 mm. per month. This slight, though continuous, deterioration of the vacuum, due to leakage of air through the excessively minute pores of the metal, necessitates periodical re-evacuation of the envelope, an operation which is performed at certain English rescue stations by the simple hand-driven Geryk pump.

Very interesting particulars concerning the cost of making liquid air have been supplied to the Research Committee by the chief English liquid-air stations. At Station A the 10-years-old plant was run for 477 hours, during which time 8705 lb. of liquid air was produced with a power consumption of 0·78 k.w.h. per lb. The cost, including power, repairs, chemicals, oil and water, but not including depreciation, establishment charges and labour, was 14·6*d.* per lb. At Station B, 8837 lb. was made in 440 hours with a power consumption of 1·17 k.w.h. per lb. The cost, including power, repairs, chemicals, oil and water, was 2·7*d.* per lb. Depreciation on the plant at 10 per cent. per year amounted to 4·3*d.*, and establishment charges to 4·2*d.* per lb., giving a total cost of 11·2*d.* per lb.

Obituary.

DR. S. H. C. MARTIN, F.R.S.

SIDNEY MARTIN, the second son of the late John Ewers Martin, was born in Jamaica in 1860, and he entered University College, London, in 1876, where he was a fellow-student and contemporary with Victor Horsley, Halliburton, and Frederick Mott. At this time many medical students at University College laid a sure foundation for their subsequent medical studies by following an extended course of instruction in biology, chemistry and physics, and Martin was one of these. He took his degree in science at the University of London in 1878, being especially attracted to biology, largely owing to the stimulating influence of that inspiring teacher, Sir E. Ray Lankester. Afterwards, during his medical studies, he came under the influence of the late Sir John Burdon Sanderson, then Jodrell professor of physiology, who was not only a physiologist but also an experimental pathologist.

After graduating in medicine in 1883, Martin began working, at the instigation of Burdon Sanderson, as an investigator in the Jodrell Laboratory, then under the control of Prof. Schäfer, who had succeeded Sanderson on the latter's appointment to the chair of physiology at Oxford. This period of the early 'eighties was one of great activity in physiology and pathology in Great Britain, and Martin devoted himself to what was then a new field, namely, the investigation of the chemical side of vital processes, and more especially to an inquiry into the nature of the so-called toxic proteids. At this time the number of workers in this branch of knowledge was extremely limited, especially in Great Britain, and Martin carried out a series of researches not only on abrine and ricine but also during a number of years on the wider question of the nature and mode of action of the toxic substances elaborated by the activity of micro-organisms in infective diseases, more especially diphtheria, tetanus and enteric fever. He developed this subject in a long series of investigations recorded in his Goulstonian and Croonian lectures delivered before the College of Physicians in 1892 and 1898.

Although Martin's main work as an investigator was in the domain of chemical pathology, and he was one of the earliest workers in Great Britain on this subject, he was a recognised authority on pathology and pathological questions in the widest meaning of the terms. Thus he had an accurate and extensive knowledge of gross morbid anatomy and was professor of pathology at University College from 1895 to 1907 and the author of a text-book on pathology. Further, all his work, both as an investigator and as a teacher of pathology, was directed to the furtherance of clinical medicine and towards increasing the power of the physician to cope with disease, and Martin was a practising physician throughout his career. He was a teacher at University College and Hospital throughout

his life, from his appointment as assistant physician in 1891, to the time of his very sudden death whilst in active work. In addition to the posts he held in his old school, he had occupied numerous other appointments, as curator of the museum and pathologist to the Middlesex Hospital, pathologist and assistant physician to the City of London Hospital for Diseases of the Chest, and physician to the Hospital for Consumption, Brompton.

In 1895 Martin was elected F.R.S. and he served on the council in 1919–1921. He was elected F.R.C.P. in 1891, served on the council 1909 to 1911, was censor in 1915-1916, and gave the Lumleian lectures in 1915. He did a considerable amount of public work and was a member of the Royal Commission on Tuberculosis, in the work of which he took an active part. During the War he served on the staff of the 3rd London General Hospital, and was a member of the Committee of Reference that carried out important work in connexion with the provision of medical officers for service overseas. He was also a member of the Executive Committee of the Imperial Cancer Research Fund from its inception in 1902, and had recently been appointed chairman in succession to Sir William Church.

MR. F. H. BRADLEY, O.M.

IN Francis Herbert Bradley, who died on September 18 in a nursing home after a short illness, mainly the result of an accident, British philosophy has lost its most distinguished representative. Born in 1846, his life covered a period of unexampled activity in this department of thought, of which his may be said to have been the central influence. Himself profoundly influenced by Kant and Hegel, and having the advantage of the stimulus which the earlier expounders of their philosophy, notably Caird and Green, gave, his method and his achievements were entirely his own, and he stands out as one of the great line of Locke and Berkeley and Hume.

It is difficult in an obituary notice to indicate the ground of this claim. We have heard of a poets' poet. Bradley was a thinkers' thinker. He never lectured and was under no temptation to popularise his thought. On one occasion of controversy with a distinguished opponent, he complained of him that he lectured instead of writing philosophy. What gave Bradley a unique position among his contemporaries was, in the first place, the vigour and incisiveness with which he put an end to old ideas, and in the second place, the splendid lucidity of the statement, and the thoroughness in the detailed application of the ideas which he believed had to be put in their place.

It was thus in his "Ethical Studies," "the most readable work on serious philosophy in English," as it has been called, which appeared in 1876, that Bradley gave the *coup de grâce* to Hedonism, and in the celebrated chapter on "My Station and its Duties" provided the concrete foundation on which the best ethical thought of our time has since been content to build. Unfortunately, this book has long been out of print. Bradley had the intention at one time of reprinting it with notes and additions, as has recently been done with the "Principles of Logic," and it is greatly to be hoped that it will be found he had carried out part of this intention.

The "Logic," which appeared in 1883, occupies a similar place. On one hand, the theory which, as in Bain and Mill, attempted to found inference on the association of ideas, is subjected to annihilating criticism; on the other hand, for the old idea of the syllogism as linear inference from isolated elements of identity, was substituted the idea of continuity with the organic system of experience as the principle of the forward movement of thought. The fertility of Bradley's work in these fields is familiar to students of philosophy in the brilliancy with which the underlying ideas of the "Principles of Logic" have been applied in logic by Bosanquet, and in psychology by Prof. G. F. Stout.

It is, however, in his last great work on "Appearance and Reality" (1893) that Bradley's originality is most conspicuous. As in the previous books he had waged relentless war against abstract ideas in logic and ethics, so here in metaphysics—or the search for ultimate reality. The goal here is not to be found in any of the forms (space-time, quality, soul or self) in which philosophers have sought it. Even the worlds of thought and will give us only partial aspects of the complete experience which alone can satisfy. Taken in themselves they are the products of abstraction—*res rationis*, as Spinoza would have said. The ultimate reality is something at once simpler and more complex. It is simpler because it is something present with us all in simple or again in exalted feeling; it is more complex because it must be conceived of as containing all the subtleties of difference and relation that science and philosophy find in it.

The dialectical form of this work, the deadly thrust with which the claim of each category is transfixed, has given the impression, even to philosophers, that it is mainly destructive. It has been called the *dis*appearance of reality. What Bradley, on the contrary, was asserting was the growing fulness of the world in which we live as we rise from the more abstract and more obviously inadequate and relative forms of reality, such as space-time or matter, to the more concrete of human personality and its life in art, morality, and religion. Bradley was a relativist before Einstein. But his relativism differed from Einstein's in being universal and in being balanced and outweighed by his sense of the necessity of presupposing an absolute as at once the criterion of the degree of relativity of any particular form of reality and the source of its significance and value.

Taken along with the volume of collected articles "Essays on Truth and Reality" (1914), and the notes and "Terminal Essays" in the new edition of the "Principles of Logic" (1922), the essential constructiveness of Bradley's work is unmistakable. But it is not by his contribution to idealistic philosophy alone that his influence on his generation has to be measured. It was the clearness and uncompromisingness with which the main principle of idealism was stated in his chief work, that, more than any other single influence, was the source of the violent reaction against it which marked the end of last century and the beginning of this under the forms of pragmatism and the new realism. The battle is still hot, and this is not the place to enter into the issues that are there being fought out. When one of the contributors to the recent volume on "Contemporary British Philosophy" suggested that it should be dedicated to F. H. Bradley as a tribute to "the chief," among the representatives of every school, there was no dissentient voice except Bradley's own to forbid it.

J. H. MUIRHEAD.

MR. H. G. SMITH.

BY the death on September 19, at Roseville, Sydney, New South Wales, of Mr. Henry George Smith, Australia loses one of her most eminent scientific men. Mr. Smith, who was born at Littlebourne, Kent, seventy-three years ago, was for many years assistant curator and economic chemist at the Sydney Technological Museum, and upon his retirement a few years ago he continued his researches in the Organic Chemistry Department of the University of Sydney. In collaboration with Mr. R. T. Baker, formerly curator of the Sydney Technological Museum, he carried out a series of investigations extending over thirty years which have thrown much light upon the scientific characteristics and economic possibilities of the essential oils and other products of the Australian flora. The main results of this work were published in two volumes entitled "A Research on the Eucalypts and their Essential Oils" and "A Research on the Pines of Australia." Mr. Smith was an unflagging worker, and his original papers, contributed to various scientific periodicals, number well over a hundred. Owing to the bulk of his work having been published exclusively in Australian journals, it received fuller recognition in Australia and America than in Great Britain.

Mr. Smith was an original member of the Australian National Research Council, and at various times he filled the offices of president of the Royal Society of New South Wales, president of the New South Wales branch of the Australian Chemical Institute (1922–23), and president of the chemistry section of the Australasian Association for the Advancement of Science. In the last-named capacity he delivered his presidential address on the chemistry of the Australian flora at Wellington, New Zealand, in 1923. He was an honorary member of many British and American scientific corporations, and was recently awarded the Syme Prize of the University of Melbourne as an appreciation of his services to scientific research in Australia. His character was marked by simplicity and sincerity, and he will be remembered as an outstanding pioneer of Australian chemistry.

WE regret to announce the following deaths:

Mr. J. E. Campbell, F.R.S., fellow and tutor of Hertford College, Oxford, and mathematical lecturer in University College, Oxford, on October 1, aged fifty-two.

Mr. Otto Hehner, president in 1891 of the Society of Public Analysts, on September 9, aged seventy-one.

Mr. J. Q. Rowett, who financed Shackleton's last expedition in the *Quest*, and provided funds for the establishment of the Rowett Institute of Research in Animal Nutrition in connexion with the University of Aberdeen and the North of Scotland College of Agriculture, on October 1, aged forty-nine.

Current Topics and Events.

AN important find of dinosaurian remains of Karroo age has recently been made a few miles west of the north-western shores of Lake Nyasa. The bones, including vertebræ, a scapula, and a coracoid, are on the whole in a good state of preservation, and it is hoped that many others will be found in the course of the more detailed examination of the area to be made in the near future. These are the first remains of the kind to be found in Nyasaland or elsewhere in this part of Africa; they have been identified by Dr. S. H. Haughton, of the Geological Survey of South Africa.

IN our issue of December 29, 1923, p. 925, we published an article commenting on the present system of distributing Government publications and their cost. In the issue of March 15, p. 407, we returned to the question, referring particularly to the question of price, and it was stated that the Library Association had made representations to the Treasury on the subject. As a result, public free libraries supported out of the rates, and the libraries of universities and university colleges in receipt of assistance from the University Grants Committee, were allowed to purchase Government publications at half-price. The matter also came before the Council of the British Association at the Toronto meeting (NATURE, August 16, p. 251). Dissatisfaction with present arrangements was further expressed at the annual conference of the Library Association held at Glasgow last month, when a unanimous resolution was passed instructing the Special Committee of the Association which has dealt with the matter to approach the Treasury again "with the view of reducing considerably the present prices of Government publications and of establishing Depository Libraries in selected geographical areas." A Memorandum has therefore been drawn up setting forth the facts as to the costs of Government publications and asking that "the Government should recognise a comparatively small number (about 20) of the largest public libraries in selected geographical areas as 'Depository Libraries' where all Government publications could be freely consulted by the public *immediately* after publication." We hope that the Chancellor of the Exchequer will give the most careful consideration to the suggestions which the Library Association is making, and that some way of meeting the difficulties of the present position will be found.

IN our issue of January 12, p. 52, we published a criticism of the argument put forward in favour of the view that foot-and-mouth disease may be introduced into Great Britain by migratory birds. A similar question is raised by a paper by W. P. Taylor and H. C. Bryant on "Relation of Wild Birds to the Foot and Mouth Disease" (*California Fish and Game*, July 1924), in which the position is reviewed in relation to the conditions in Mercred County, California, mainly with regard to local spread rather than to introduction from a distance. The arguments for and against the bird theory are marshalled, the latter preponderating; but admittedly there is no proof, either positive or negative. We do not think that it has been seriously suggested in Great Britain that even if birds were proved responsible the remedy would lie in measures for their extermination, but here we read, under the heading "Psychological

Aspect," that in California this policy is strongly advocated by interested but ignorant parties. The writers even seem, at first sight, to make some concession to this view by devoting a section to the relative merits of different methods of destruction, not excluding poison gas; but this is perhaps mainly for the purpose of demonstrating the futility of all of them. They point out, for example, that shooting may lead to the wider dispersal of the surviving birds, and that officials charged with measures for the control of birds might become more dangerous potential carriers of infection than the birds themselves; only the killing of turkey buzzards which actually come to feed on diseased carcases is considered feasible. The writers conclude that any policy of destruction would be unjustifiable, impracticable, and useless—or worse. They might have added that any wholesale elimination of bird-life would probably deal an effective deathblow to all agriculture in the region.

THE Carnegie Institution of Washington, acting through its Advisory Committee in Seismology, and the Seismological Society of America, have agreed on certain methods to promote seismological research in both scientific and practical lines. The Advisory Committee was appointed four years ago, and decided to limit its work at first to the west coast region of the United States, where earth-movements occur in considerable variety. It has had the advantage of the co-operation of the Ukiah and Lick Observatories, the U.S. Coast and Geodetic Survey, the U.S. Geological Survey, and the U.S. Hydrographic Office, and can already point to some valuable results. The two observatories mentioned are continuing their observations of latitude in order to establish or disprove the northward crustal drift indicated by earlier observations. A fault-map of California has been published, and also a bathymetric chart of the continental shelf from San Francisco to Point Descanso, and a new primary triangulation has been made of the entire coast region south of San Francisco. The Seismological Society was founded in 1906, and its Bulletin, first published in 1911 and issued quarterly, has produced many useful memoirs. The agreement with the Advisory Committee provides that the latter shall bear the cost of printing specific articles which the Society could not otherwise undertake, and this enables the Society to issue an invitation to students of seismology and related subjects to use the Bulletin as a means of communication with their fellow-workers in other countries. The chairman of the Committee on Publication is Prof. S. D. Townley, Stanford University, California.

THE fifth annual report of the Tidal Institute of the University of Liverpool records an important administrative change: the Institute is now governed by a joint committee of the University and of the Mersey Docks and Harbour Board, one of the University representatives being nominated by the Admiralty. The same committee also governs the Bidston Observatory. The Liverpool Steamship Owners' Association has provided nearly all the funds required for the Institute during the past year and also for the coming year. The Institute is also making preparations for partial self-support by engaging in commercial work on a comparatively extensive scale. A special method of analysis and prediction of tides suitable for large schemes of routine work has been devised; a tide-predicting machine is also being constructed for the Institute, the cost being defrayed by generous gifts from Liverpool shipowners. The machine, which is to be housed at the Bidston Observatory, is to be much larger than the Kelvin machines, and will incorporate new features of design. The Institute will in future receive an increasing share of Admiralty tidal work, and has already been responsible for tide-predictions for seven Colonial and three Japanese ports. The theoretical work of the Institute has been actively continued during the past year, particularly in relation to meteorological effects on sea-level, and during October, November, and December 1923, daily forecasts of these effects on the sea-level at Liverpool were supplied to the Marine Surveyor of the Mersey Docks and Harbour Board, in time to be of practical value as supplementing the information given in the regular tide tables.

THE belief has been expressed that the airship industry will pass with the ZR3 from Germany to the United States, where the Goodyear Tyre and Rubber Co. has purchased all rights. On the other hand, the experience gained in the design, construction, and test of the latest model will go far to tide Germany over the duration of the restrictions imposed by treaty. Comparison with the first really successful Zeppelin shows the progress in design.

	Completed.	Volume ($m.^3$).	Total lift in tonnes.	Disposable load in tonnes.	Power (kw.).	Max. speed (km./hr.).
LZ3 .	1906	11,500	12·5	3·5	2×65	45
ZR3 .	1924	70,000	81	41	5×300	140

The following table gives the performance of 72 German naval airships:

Cause of writing off.	Number.	Av. life (months).	Av. service flights.
Enemy action . . .	24	6	15
Accidental fire . . .	12	7½	17
Weather and mishaps . .	22	7	12
Worn out	5	19	36
Dismantled after Armistice	9	16	21
Total . .	72		

Latterly, an airship coming within range of fighting aeroplanes met with almost certain destruction. For commercial airship transport, eliminating war and fire risks (on the assumption of adequate supplies of helium), and allowing for the effects of the Armistice, a probable useful life of much less than 18 months and 32 voyages is indicated. The receipts would clearly not pay capital and running costs without a

heavy subsidy. It will be of fundamental interest to observe whether the ZR3 falls short of or improves on these figures.

THE Public Works Branch of the Department of Industries and Labour of the Government of India has issued a second supplement to the Triennial Review of Irrigation in India 1918–1921 (issued in 1922), containing an account of State irrigation works carried out in the year 1922–3. From this we learn that, averaged over the plains of India, the rainfall was 5 per cent. above normal. The chief features of the distribution of the monsoon rainfall during the year were (1) the excess in the tract of country extending from the east and north Punjab to Orissa and Bengal, and (2) the deficiency over the Peninsula, excluding the west coast, and in the region of north-west India comprising the Rajputana desert and the country to the west. During the year 1922–1923, the total area irrigated by all classes of works in India, excluding the Indian States, amounted to 28⅓ million acres, which exceeds the average area irrigated during the preceding three years by about ¾ million acres, and the record area of 28·1 million acres irrigated in 1919–20, by more than 180,000 acres. The largest irrigated area was in the Punjab, in which province 10¾ million acres were irrigated during the year. Next came the Madras Presidency with 7⅓ million acres, followed by Sind with 3⅝ million acres and the United Provinces with 2⅝ million acres. The total capital outlay, direct and indirect, to the end of the year 1922–3 on irrigation and navigation works, including works under construction, amounted to Rs.84,57 lakhs, the gross revenue to Rs.10,06 lakhs, and the working expenses to Rs.3,85 lakhs. The net return on capital was, therefore, 7·3 per cent. From the crop returns, 13 per cent. of the total cropped area was irrigated by Government irrigation works, and the estimated value of the crops so irrigated amounted to nearly 1¾ times the total capital expended on the works, a very striking testimony to the value and efficiency of the latter.

THE September number of the *Scientific Monthly* contains an interesting article by Dr. Paul D. Foote, of the Bureau of Standards, on old and new alchemy. The old alchemists were of two types—the precursor of the modern "successful oil-stock promoters," and the persevering predecessors of the modern chemists. Medieval alchemy was a logical consequence of the theory of Aristotle that all matter is composed of one primary matter, on which different forms could be impressed; modern alchemy is an equally logical consequence of the hypothesis that matter is composed of two primary substances, negative and positive electricity, the grouping of the particles of which, the electron and the proton, into different forms, is the study of the modern science of atomic structure. Dr. Foote describes the recent theories of matter and points out their bearing on the problem of the transmutation of the elements. The experiments of Rutherford on the disintegration of the nitrogen nucleus, for example, by α-rays, have to some extent removed this problem from the realms of pure speculation. The yields are still meagre: if all the four and a half billion billion α-particles from 1 gram of radium and its products in one year were projected into an aluminium target, the hydrogen liberated by the disruption of the nuclei would occupy 1/1000 cubic millimetre.

A FULL report of the conference held in July last to consider the most effective means of securing the adoption of decimal coinage and the metric system appears in the September issue of the *Decimal Educator*, published by the Decimal Association. Representatives were present from Great Britain, the Dominions Overseas, and the United States, and it was resolved to urge the Government to appoint a committee to consider the advisability of making the penny one-tenth of the shilling, and to get rid of the confusion introduced into the measurement of volume by the change from the wine gallon to the Imperial gallon in Great Britain a century ago, without consultation with America. The conference suggested that the two gallons now in use should, by co-operation with America, be made identical and equal to four litres, so that the quart would be exactly a litre.

AN account is given in *The World's Health* for August (the organ of the League of Red Cross Societies) of the Papworth (Cambridge) village settlement for tuberculosis by the Director, Dr. Varrier-Jones. The colony numbers 196 persons. Patients are admitted in all stages of the disease, and the work they do is graduated according to their capacity. There is no limit to their length of residence, and they are encouraged to settle permanently with their families. It is thus possible for patients whose working capacity is below normal to continue doing part-time work for many years, instead of having to give up entirely in competition with the outside world. Dr. Varrier-Jones holds that this procedure prolongs life and renders it happy and useful, as well as being a sound business proposition.

THE Minister of Health has appointed the following committee to deal with the question of the supply of morphine and heroin to drug addicts: Sir Humphry D. Rolleston, Bt. (chairman); Sir William H. Willcox; Mr. J. W. Bone; Dr. R. W. Branthwaite; Dr. G. M. Cullen; Prof. W. E. Dixon; Dr. J. Fawcett; Mr. A. Fulton; Mr. J. Smith Whitaker. The committee is "to consider and advise as to the circumstances, if any, in which the supply of morphine and heroin (including preparations containing morphine and heroin) to persons suffering from addiction to those drugs may be regarded as medically advisable, and as to the precautions which it is desirable that medical practitioners, administering or prescribing morphine or heroin, should adopt for the avoidance of abuse, and to suggest any administrative measures that seem expedient for securing observance of such precautions." The joint secretaries of the committee are Dr. E. W. Adams and Mr. R. H. Crooke, Ministry of Health, Whitehall, S.W.1, to whom all communications should be addressed.

IN addition to the awards of the Institution of Civil Engineers for papers announced in NATURE of October 4, p. 513, the Council has awarded a Telford Premium

to Prof. Louis N. G. Filon (London) and an Indian Premium to Mr. F. C. Temple (Jamshedpur, India).

THE Institute of Metals programme for the session 1924–25 covers the work not only of the parent Institute, but also of its six branches located in various metallurgical centres. More than thirty lectures dealing with various phases of non-ferrous metallurgy are enumerated in the programme. Prof. H. A. Lorentz is to deliver the annual May lecture. Copies of the programme can be obtained from the secretary of the Institute, Mr. G. Shaw Scott, 36-38 Victoria Street, Westminster.

AN attractive list of free popular lectures to be delivered on Saturday afternoons at the Horniman Museum, Forest Hill, has just been issued. The lecture hour is 3.30, beginning on October 11, and the subjects of the lectures are "The Development of Modern Radio Communication," "Cornish Scenery and its Causes," "Social Life among Insects," "Some Famous Pharaohs," "The Amulets of Ancient Egypt and of Modern London," "Evolution and Darwinism," "Prehistoric Man and the Land of Lyonesse," "The Eggs of Animals," and "The Glory that was Thebes." No tickets will be required.

THE Chadwick Public Lecture programme for this autumn includes lectures in London on "Defective Hygiene and Child-Life," with special reference to the effect produced on growth and development of children by town dwelling and slum areas, by Dr. Lawson Dick; "Rats," by Mr. Mark Hovell; "Smoke," with a review of its causes, its effects on vegetation, fabrics, masonry and metal work, and its influence on health and the death-rate, by Prof. J. B. Cohen; and "Ante-Natal and Post-Natal Child Physiology and Hygiene," by Dr. W. M. Feldman. Further information about these lectures can be obtained of the secretary of the Chadwick Trust, Mrs. Aubrey Richardson, at 13 Great George Street, Westminster.

MESSRS. J. and A. Churchill announce for publication early next year a "Dictionary of Perfumery," by E. J. Parry, which will deal with the raw materials of the perfumery trade and with allied subjects from the points of view of the chemist, the manufacturer and the user. The work, which will be in two volumes, will contain special signed contributions by Messrs. A. C. Marrin, C. T. Bennett, T. H. Durrans, M. Dewhirst, A. Garden, M. Salamon, and W. H. Simmons.

MESSRS. Thomas Murby and Co. are publishing shortly "A Handbook of the Geology of Ireland," by the late Prof. G. A. J. Cole and T. Hallissy, which is based on Prof. Cole's contributions to "The Handbook of Regional Geology," a German publication. Another work in the same publishers' list of announcements is "Useful Aspects of Geology," by Prof. A. J. Shand, which aims at giving an account of the various ways in which a knowledge of geology can be turned to use, and at showing where to go for fuller information on each particular subject.

MESSRS. Ernest Benn, Ltd., announce for early publication, under the title "Science and Labour," the principal papers read at the Conference on Science and Labour at the British Empire Exhibition in May last. The subjects dealt with include The Place of Science in Government; Scientific Research in Relation to Industry; The Co-operation of Science and Labour in Production; Science and the Human Factor, and Science in Educational Organisation. Among the contributors are Lord Askwith, Sir Richard Glazebrook, Sir Richard Gregory, Mr. Hugo Hirst, Sir Thomas Holland, Sir Oliver Lodge, Sir Arthur Newsholme, and Mr. Sidney Webb.

Our Astronomical Column.

THE TOTAL SOLAR ECLIPSE OF JANUARY 24, 1925.—The Journal of the R.A.S. of Canada for August–September 1924 contains an interesting article on this eclipse by R. M. Motherwell, of the Dominion Observatory, Ottawa, illustrated by a map of the track over Canada and the United States.

The eclipse comes at a bad season of the year, with a rather low sun, and the weather prospects are poor; but it is visible in a very populous region, including the observatories of the University of Toronto, of Columbia University, and of Vassar College, so that the most is likely to be made of the occasion. Portions of all the great lakes lie within the zone of totality; Niagara and Buffalo are near the central line. New York is just outside the southern boundary.

Totality lasts nearly two minutes on the central line. A large partial eclipse is visible throughout the British Isles. In the Western Hebrides the solar crescent left uncovered will be only some 8″ in width, but the sun will be too low there for any useful work.

This eclipse is a recurrence after the triple Saros of that of December 1870 visible in South Spain, North Africa, and Sicily. It was interesting from Prof. Young's discovery of the reversing layer, and the beautiful coronal photographs obtained by Mr. Brothers.

PROF. LA ROSA'S THEORY ON THE CAUSE OF STELLAR VARIABILITY.—Prof. La Rosa's suggestion that stellar variability may be explained on the ballistic theory of light was recently noticed in this column. The theory supposes that light follows the law of projectiles, the total velocity being compounded of the velocity of the source and that of light, so that in the case of a distant star revolving in an orbit, the light that leaves the star in equal time intervals arrives in unequal intervals, thus causing an apparent light-variation.

Prof. de Sitter criticises the theory in Bull. Astron. Instit. Netherlands, vol. ii. No. 57, on the ground that since the number of waves of any definite length that enter the eye per second would be altered in the same ratio as the light-intensity, an enormous Doppler shift, far beyond any actually observed, would result if the theory were true.

Prof. La Rosa replies to this criticism in *Astr. Nach.* No. 5319. He notes that his theory is not really a wave-theory but a corpuscular or "quantum" one. Still it is convenient to use the language of the wave-theory. The point he lays stress on is that the spectral shift observed does not depend on the number of waves that enter the eye per second, but on the distance between crest and crest of these waves, and this distance would depend on the actual velocity of the star in the line of sight.

Probably most astronomers will consider that Prof. La Rosa's theory is difficult of acceptance on other grounds (notably the Michelson-Morley experiment); but that possibly the particular objection raised by Prof. de Sitter is not decisive.

Research Items.

A CONGO FETISH.—Mr. H. V. Hall figures and describes in a recent issue of the *Museum Journal* one of the interesting and important wooden statuettes commonly known as "nail fetishes" from Loango, the coast district north of the Congo. The figure, about 32 inches high, represents a man standing with the left hand resting on the hip, the right raised as if to throw a spear or inflict a blow with a bush knife. The top of the head is left unfinished. It was formerly covered with a cap of hardened paste. Such caps were of paste of varied composition, but usually containing poisonous elements. This paste embodied the fetish force or power. It was sometimes attached in the form of a casket to the abdomen or chest. These fetishes are said to have been employed when other means of detecting crime, such as the ordeal by poison, had failed. In the course of a divinatory ceremony, the power of the fetish is loosed against the offender by the firing of a gun; but for certain offences a nail, sometimes heated, is driven into the figure. It is also used in taking an oath in a solemn engagement; both parties strike a blow or two on the same nail, while each adjures the fetish to eat him up if he breaks his vow.

THE ABORIGINES OF TASMANIA.—In the first R. M. Johnston Memorial Lecture delivered to the Royal Society of Tasmania last session, Sir T. W. Edgeworth David gives a useful summary of the geological evidence of the antiquity of man in the Australian Commonwealth, with special reference to the Tasmanian aborigines (Proc. Roy. Soc. Tasmania, 1923). He also records some new observations on the occurrence of stone implements, much resembling the earlier palæoliths of Europe, in the superficial deposits of Tasmania. These implements have been found not only in river drifts and lake beds of great antiquity, but also in raised beaches from three to five feet above the present sea level. Indeed, considering all the evidence, "if aboriginal man in Tasmania was really contemporaneous with one of the last great ice ages, he must have witnessed a sea level perhaps no less than 200 feet lower than it is at present." He must have crossed Bass Strait when it was either dry land or only a narrow strip of sea; and as the dingo did not reach Tasmania, the date of this crossing must have been anterior to the arrival of the Australian aboriginal in southern Australia. Implements have not yet been discovered in Tasmania in association with the remains of the large extinct marsupials, and Sir Edgeworth David suggests that special search should be made in the older sand dunes such as those of King Island, where remains of Nototherium have been found. He also thinks that further explorations are desirable in the peat deposits and caves. Excavations for harbour works and dredgings in Bass Strait should be specially watched. Evidence of several advances and retreats of the ice during the glacial period has already been noted in Tasmania, and there seems to be some hope that these may eventually be correlated with similar fluctuations in the northern hemisphere.

SCOTTISH ANTHROPOMETRY.—Every fresh analysis of the anthropometrical characters of the people of Scotland emphasises the impossibility of discovering racial traits of any significance in a general sample of the population. Since the first invaders made their settlements, fresh waves of immigration from outside and movements within the boundaries have tended to swamp the original distinctiveness of the races. The general population has become too mixed to be significant, so that the anthropologist must now rely only on the chance of finding in certain localities pockets of individuals, who through a modified geographical isolation, or through a more effective isolation due to a persistent habit of intermarriage, have retained some indications of their origin. For this reason special value attaches to a small "Illustrated Catalogue of Specimens from Prehistoric Interments found in the North-east of Scotland," and contained in the Anthropological Museum at Marischal College, University of Aberdeen, of which Prof. R. W. Reid was the originator. The work, compiled with great care by Prof. Reid and his colleagues, contains an analysis of the human remains contained in some score of short stone-cists, along with descriptions of the beakers and other objects associated with the burials. The restricted area from which the interments have been drawn allows of easy comparison with the present-day population in the same district, which has recently been shown, by Dr. Tocher's researches, to be outstanding amongst the peoples of the Scottish mainland on account of the large proportion of brachycephalic individuals it contains. The Catalogue shows that the earliest settlers who have left traces of their habitation in the north-east of Scotland were markedly brachycephalic, with a brain-capacity similar to that of the average modern Scot, but of considerably smaller stature. They probably belonged to the broad-headed Alpine race which overflowed western Europe from the east during the Bronze Age. One notable exception is catalogued, a brachycephalic individual found at Catterline in Kincardineshire in 1923, whose brain-capacity was considerably greater than the modern average, 60 c.c. greater even than that of the large-headed Robert the Bruce, and whose stature was approximately 5 feet 8 inches. To this 3000 to 4000 years old race, or to subsequent immigrations from its continental settlements, may be attributed the predominant broad-headedness of the modern inhabitants of Aberdeenshire and the surrounding counties.

PROTECTING WOOD AGAINST TERMITES.—Termites are particularly destructive to untreated wood in any form both in the United States and the tropics. Bulletin 1231 of the U.S. Dept. of Agriculture, by Mr. T. E. Snyder, is devoted to an account of tests of methods of protecting woods against the ravages of these insects. These experiments were conducted between 1912 and 1922, while supplementary data were obtained from inspections of treated timbers made from 1909 to 1922. The most effective preservative in protecting timber to be set into the ground was found to be coal-tar creosote. Impregnation by the "open-tank" method renders wood resistant to termite attack for at least 15 years. Impregnation by the full-cell process enables wood to resist these insects for at least 25 years, and this method is recommended for use in tropical countries. Brushing the creosote, in several coats, on timber will add from 2 to 5 years to its life. For interior woodwork, furniture, cabinet woods, etc., impregnation with zinc chloride, bichloride of mercury, sodium fluoride or chlorinated naphthalene is effective. Another protective method is to treat the hidden cheaper cores of furniture, cabinet woods, etc., with preservatives during manufacture, and then overlay them with veneers of termite-resistant woods. No species of tree apparently has wood which is absolutely resistant to termites, but among the most resistant woods are the teak and sal of India—a fact well known in that country; cypress-pine and camphor-wood of the Orient; greenheart of South America; redwood, western red cedar or giant arborvitæ, incense cedar, Port Orford cedar, yellow cypress, and species of

juniper of the United States. Wood-pulp products were also used in the tests and consisted of processed boards utilised in interior finish and as substitutes for lath, tiling, etc. These products were found to stand the tests best when crude carbolic acid or coal-tar creosote were added to them, although the odours are a disadvantage. It is stated that a large market for both crude and finished forest products could be found by American manufacturers in South America, and other tropical lands, provided satisfactory termite-proof products could be furnished.

PERMEABILITY OF LEAF CELLS.—Prof. H. H. Dixon describes a new method for determining the changes in the electrical conductivity of leaf cells, in Notes from the Botany School, Trinity College, Dublin, iii., 1924, 272 (see also Proc. Roy. Dublin Soc. xvii., No. 45, 1924). The method consists of placing a cut square of leaf on the horizontal arms of two plate electrodes, the latter being moistened with sap expressed from the leaf. It is found that temperature affects the permeability of leaf cells considerably, a rise of 10° C. increasing the conductivity (on an average) to 1·33 times as much. Further, changes of temperature of the order of 10° C. are shown to occur readily in insolated leaves, and hence considerable changes in permeability may be produced in a short time, which have doubtless an important bearing on the movement of materials in the leaf.

CARBON ASSIMILATION IN CONIFERS.—An interesting study of the ecology of carbon assimilation has been made by M. G. Stålfelt (Meddel. fr. Statens Skogsförsökanstalt, 21, 1924, p. 182). This deals with the rate of carbon assimilation of pine and spruce leaves in relation to temperature, light intensity, and the carbon dioxide content of the air. The measurements were carried out under natural conditions. The rate of assimilation falls off very markedly in older leaves at the higher light intensities, but in light intensities of about 30 per cent. of full sunlight, leaves of five years of age absorb much more carbon dioxide per hour than do young leaves (a year old). There is little or no assimilation below about 5 per cent. of full sunlight. The chlorophyll content of the leaves was also determined. For *Pinus sylvestris* the average was 15 mgm. and for *Picea excelsa* 10·6 mgm. in 10 gm. of fresh leaves. The numerous data might possibly repay further analysis. The author discusses xeromorphy in conifers in the light of his findings. A résumé in German is given.

THE STRUCTURE OF THE BASQUE PYRENEES.—In the *Boletin de la Sociedad Iberica de Ciencias Naturales* for 1923, Mr. P. W. Stuart-Menteath vigorously assails the recent work of the French geologists who have been engaged in revising the geological maps of the Pyrenees. While the official interpretation of the structure invokes thrusting on a large scale, Mr. Stuart-Menteath asserts that in the neighbourhood of the old mine of San-Narciso—a region that he has studied in great detail for many years—there is no evidence whatsoever of a thrust plane or of an abnormal sequence. Such evidence as has been put forward in support of the overthrust hypothesis is, according to this observer, due to a complete misreading of the stratigraphy. A formation, for example, that has been mapped as Carboniferous he claims as Flysch; and the underlying "mylonites" are, he says, ordinary conglomerates which locally contain Cenomanian fossils attached to pebbles of ophite. Collaborating with M. E. Fournier in the *Bull. de la Soc. Geol. de France*, xxiii. p. 102, 1923, detailed evidence is presented of the straightforward succession in and around the mine of San-Narciso. The mine itself has been abandoned and filled with water for thirty years; but, despite this obstacle to observation, a band of limestone occurring beneath undoubted Palæozoic rocks in the lower levels of the mine has been considered as Cretaceous, and therefore as affording sufficient proof of an overthrust to bring the controversy finally to an end. The authors, however, maintain their old view, based on actual investigation of the mine itself before it was closed down, that the limestone in question is of Devonian age, and that it is normally surmounted by Carboniferous and Trias, which in turn in a neighbouring syncline is followed by Cretaceous. It is to be hoped that the French geologists whose maps so flagrantly contradict the work of Mr. Stuart-Menteath will now discuss the evidence which has led them to disregard his observations and conclusions.

HOURLY RAINFALL IN UNITED STATES.—The *Monthly Weather Review* for April has two articles on variations in hourly rainfall at different places in about the centre of North America which are confirmatory of each other. The first article, for Lincoln, Nebr., is by Mr. H. G. Carter, Meteorologist at the Weather Bureau. At Lincoln there is twice as much rain in May as in October, and May has 50 per cent. more hours with rain than October, but the average shower in October lasts 25 minutes longer than the average shower in May. The data used in the paper cover 19 years, 1905–1923, and are for the months of May to October only. For the entire period, about 34 per cent. of the total amount falls during the twelve hours from 6 A.M. to 6 P.M., and about 66 per cent. from 6 P.M. to 6 A.M. In August 74 per cent. of precipitation occurs during the night hours, while in October the night precipitation is 53 per cent. and the day 47 per cent. The greatest rain frequency occurs in May, the least in August. The second article deals with hourly precipitation at Topeka, Kans., and is by Mr. S. D. Flora, Meteorologist at the Weather Bureau. Three-fourths of the precipitation falls in the six summer months and is largely the result of thunderstorms. The hour with the heaviest fall of moisture is near sunrise, and the hour with the least from noon to 1 P.M. The average fall of rain at Topeka from 5 A.M. to 6 A.M. is more than three times as great as from noon to 1 P.M.; more than 60 per cent. of the average day's precipitation occurs between 6 P.M. and 6 A.M. The results obtained will be welcomed by those interested in rain insurance and by many others; some of the conditions which control the results would doubtless be similar to the conditions in Europe.

WINDS OF CENTRAL EUROPE.—Dr. Albert Defant, of the Institute of Cosmical Physics of the University of Innsbruck, contributes an appendix (just issued) to the 1920 Yearbook of the Central Office for Meteorology and Geodynamics, Vienna. The appendix consists of a discussion of certain characteristics of the distribution of wind over the area which, before the War, was subject to the Austro-Hungarian monarchy. The data are derived from 372 wind-stations—236 in Austria, 113 in Hungary, and 23 in Bosnia-Herzegovina—and in most cases observations from ten years are used; a list of the places and dates is given. The collection of the data was undertaken during the War, for war purposes. For each station the wind-observations for each of the twelve calendar months, at the separate hours 7 A.M., 2 P.M., and 9 P.M., were classified according to the direction of the wind (8 compass points being used) and according to the intensity (in five classes). The summaries for the frontier regions were reproduced lithographically during the War, but otherwise the data have remained unused. This

appendix now summarises the data for the two months January and July (taken as typical of winter and summer) by means of eighteen maps showing by isolines the distribution of various wind-characteristics. Six maps show the lines of equal frequency of (*a*) calms or light winds, (*b*) moderate winds, and (*c*) strong winds, for the two separate months, combining the results from the above three hours. Four maps show lines giving at each point the vectorial mean wind-direction for the separate hours 7 A.M. and 2 P.M. in January and July; four others show the lines of equal vectorial mean wind-velocity v for the corresponding times. Two maps give the lines of equal wind-velocity V, averaged without regard to direction, for the two months separately, combining the results for the three hours; while the last two maps indicate the value of the ratio v/V, which is evidently a measure of the constancy of direction of the wind at each place. It is impossible to describe these various maps briefly, but, as regards wind-direction, they show that the wind is mainly westerly, though, particularly in the mountain regions, there are certain interesting disturbances of this general current.

THE RANGES OF THE α-RAYS FROM URANIUM I AND URANIUM II.—Wölsendorf fluorspar shows pleochroitic haloes, due to the action of the α-rays from small specks of radioactive substances. The phenomena are described by Dr. B. Gudden in the *Zeitschrift für Physik* of August 8. The haloes differ from those seen in mica, owing to the fact that fluorspar is bleached by rapid α-particles, and it is only at the end of the range that this action is reversed, and the material is coloured by their action. A section through the radioactive particle shows a series of fine circular lines corresponding to the different radioactive substances which have sent out α-rays. Measurements with different specimens show the haloes of uranium I and uranium II (as a rather broad line), ionium, radium, polonium, radium emanation, radium A, and radium C^1. Although the haloes of uranium I and uranium II are not separated, it is possible from the measurements to determine the ranges in air of the α-particles from these substances, with an uncertainty of less than one per cent. The values obtained, 2·68 and 2·76 cm., are 1·5 mm. greater in the case of uranium I and 1·5 mm. smaller for uranium II than those previously regarded as correct. They show that for small values of the disintegration constant, λ, there are large variations from the linear relationship between $\log \lambda$ and $\log R_0$, and they make the mean life of uranium II about fifty times as long as was previously suspected.

ELECTRIC ARCS WITH NON-INCANDESCENT CATHODES.—Messrs. Stark and Casuto, using a brass cathode rotated under the anode and so kept cool, were unable to maintain an arc; but Dr. H. Stolt describes experiments in the *Zeitschrift für Physik* of August 8 which show that if the disc is well polished, an arc can be produced. Still better results were obtained with cathodes of copper, silver, and gold, but there was no success with aluminium. The anode was a 0·3 cm. rod cut off at right angles to the axis, or with a little slope, and was held in a spring holder near the outer edge of the disc. The arc was struck by pressing the anode towards the rotating cathode against the spring, and at once releasing it. With small currents the disc could be touched with the finger at a point where the arc was in existence 1/100 sec. previously; and even with 10 amperes the temperature here does not appear to exceed 200° C. Spectroscopic examination of the arc throughout its length also showed no incandescence at the cathode. Very similar results were obtained by Nicol, who caused an arc to rotate between ring electrodes of copper in a radial magnetic field. Child and Bräuer assume that electrons are produced at the cathode by collisions of positive ions, but consider that a high temperature is necessary; apparently, however, this is not the case.

INFLUENCE OF MAGNETIC FIELDS ON PHOSPHORESCENCE.—When an excited phosphore is heated, illuminated with light which does not excite it, or placed in a strong electric field, the rate at which it gives off light is increased, and the time during which it remains phosphorescent is diminished. In the *Annalen der Physik* for September, Dr. E. Rupp shows that similar results are obtained in a strong magnetic field; though the smallest field which gives a visible result is 17,200 gauss, using Zn Cuα five minutes after excitation. The largest field available was 45,000 gauss, since larger currents could not be used in the magnet employed. Even with this field the effect was smaller than that produced with an electrostatic field of 10,000 volts per cm., and it is possible to employ very much larger electric fields than this. Thus it was not possible to observe all the phenomena obtained with electric fields by using magnetic fields, though the phosphore flashed brightly when the current was switched on, and this can be repeated once or twice, though with diminishing intensity. The extra light in the flash from a phosphore was found to be partly polarised perpendicular to the magnetic lines of force. This is more distinct with zinc manganese phosphores than with zinc copper phosphores, and there is no such phenomenon in an electrical field. F. Schmidt has explained the electrical phenomenon as being due to an alteration in the movement of the electrons, and to a rotation of the polarised atom pairs; the same explanation seems to hold for the magnetic action, since an electric field $E = vH$ is produced when magnetic lines of force pass through a space with velocity v. The polarisation of the light given off in this case seems to indicate that, in addition to this, the emission from the phosphorescent centres is directly influenced by the magnetic field, the orbits of the electrons being affected as in the Zeeman effect. The different atomic magnetism of the elements involved may also be of importance.

ROTATORY DISPERSION.—In the August number of the Journal of the Chemical Society, Lowry and Richards describe some measurements of the rotatory dispersions of octyl alcohol and octyl oxalate. A large number of wave-lengths was used in each case and the measurements were carried out with the greatest care. The results showed that the rotatory dispersion of octyl alcohol can be expressed completely by one term of Drude's equation. In the case of the ester, the results approximated to the inverse-square law of Biot, but could not be expressed either by that law or by one term of Drude's equation. The dispersion is therefore not simple, but complex.

THE PRODUCTION OF DIAMONDS.—In the April-July number of the *Compte rendu des séances de la Société de Physique*, of Geneva, Duparc and Kovaleff describe an experiment in which carbon disulphide and "a metal easily sulphurised" were compressed to 8000 atm. for fifteen minutes. When the metal cylinder was dissolved in an acid a small residue, transparent, colourless, or slightly yellow, of irregular form, and capable of scratching glass, was found. It was birefringent and had a high index of refraction, but no density measurements were made. After a few days the residue fell to a powder. It is assumed that the region of stability of diamond at the ordinary temperature commences at a pressure below 8000 atm.

Ferrous Alloys Research: The Iron-Oxygen Equilibrium.

AT the autumn meeting of the Iron and Steel Institute held in September at the British Empire Exhibition, Wembley, an account was given by Dr. Rosenhain and some of his colleagues of an investigation of the alloys of iron which was begun by them rather more than a year ago under the auspices of the Ferrous Alloys Research Committee, which is the successor of the Alloys Research Committee of the Institution of Mechanical Engineers. The new Committee contains representatives of the Royal Society, the Institutions of Civil Engineers, Mechanical Engineers, Electrical Engineers, Naval Architects, and Mining and Metallurgy, and the Iron and Steel Institute. Under the auspices of this Committee, and with the concurrence of the Advisory Council of the Department of Scientific and Industrial Research, a beginning has been made upon a programme of work which is more ambitious, more difficult, and more expensive than anything which has hitherto been attempted. As Dr. Rosenhain points out in his introduction (Part I.) to the research, in spite of the large amount of scientific research devoted to the alloys of iron, much fundamental knowledge as to the constitution of the binary systems is still lacking. Most of the alloys hitherto investigated contain some carbon in addition to the special alloying metal, and this may, and probably does, have a profound influence on the equilibrium in question. Many of the most important industrial alloys contain three or more elements, and their composition has been arrived at largely by empirical methods. The precise influence of any particular element is largely a matter of guess-work. For this reason it is eminently desirable that the equilibria of the binary systems should be determined with the purest materials and the highest accuracy possible.

Messrs. Tritton and Hanson are responsible for Part II. of the research, which deals with the equilibrium of iron and oxygen, and a brief survey of their experiments will show something of the difficulties encountered in investigations complying with the above-mentioned standard. The iron was prepared by the method of Cain, Schramm, and Cleaves from an electrolyte containing pure ferrous chloride and sodium chloride. The product was satisfactorily pure except for a rather high oxygen content, due, so the authors think, to the formation of rust in the iron, which was deposited in a slightly porous form. Special attempts were made to prepare iron free from oxygen. At a later stage of the investigation a high-frequency Ajax-Northrup induction furnace became available, and the authors melted electrolytic iron previously purified by heating in hydrogen to 1200° C. in a vacuum of about 2 mm. of mercury, but the metal was not free from oxide. After various attempts, the best method was found to be to blow purified hydrogen on the surface of the metal during melting and for a period of fifteen minutes when molten. Even then the resulting metal was found to contain an amount of oxide estimated to represent about 0·08 per cent. oxygen. Both china clay and magnesia pots were used. It is to be gathered from the authors' paper that no iron prepared by them contained less than the above-mentioned amount of oxygen.

One of the greatest difficulties was to obtain pots and other refractory articles suitable for the work. Those made either of silica, china clay, or alundum will not hold molten iron containing much oxide for more than a few minutes, owing to the rapid attack on the pot by the oxide. Special pots had therefore to be manufactured at the laboratory, and a new method has been developed, involving direct fusion of the refractory in an electric arc, for producing pots having internally glazed surfaces of great resistance to chemical attack. The refractory (previously melted and powdered) is placed in a suitable receptacle and spun in an electric arc in such a way as to form in a few minutes a well-shaped pot having a body of highly fired material, the internal surface of which has been completely molten, leaving a glazed surface on the interior of the pot. Only in these was it found possible to hold molten iron and iron oxide at the same time. For low-oxygen melts, china clay pots were used, while for the higher oxygen alloys, bonded pots of fused magnesia were found best.

Another difficulty which had to be overcome was

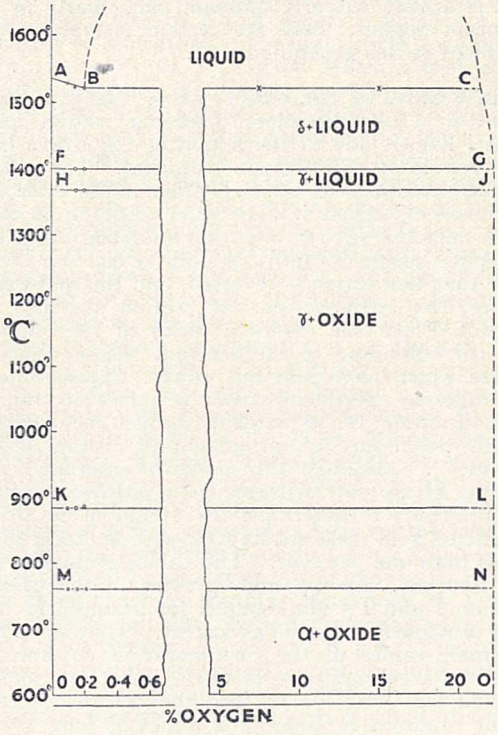

FIG. 1.—Iron-oxygen equilibrium diagram.

the contamination of the thermocouples, due apparently to the penetration of the couple protector by the iron vapour. The best method was found to be to use a very low-sided pot and to blow nitrogen across the surface of the melt. Contamination was worse in the pure platinum wire than in the platinum 10 per cent. rhodium alloy. Accordingly the authors substituted thermocouples of wires containing 5 per cent. and 20 per cent. of rhodium, which gave a sufficient sensitivity for thermocouple work.

In spite of these improvements a certain amount of contamination always occurred, so that the couple needed frequent testing and the removal of the contaminated portions of the wire. The freezing-point of iron of the lowest oxygen content was found to be 1535° C. referred to 1555° C. as the melting-point of palladium. This is probably a very close approach to the freezing-point of pure iron, since, in spite of the presence of oxygen, the slight slope of the liquidus

curve of the iron-oxygen diagram indicates that the effect of this amount of oxygen must be small. The melting-point of the oxide stable at these temperatures was found to be 1370° C., and that of the δ change point in iron 1407° C.

The authors have given the iron-oxygen equilibrium diagram between 0·1 per cent. and 22 per cent. of oxygen, represented by the compound FeO. This diagram, which is reproduced in Fig. 1, is of considerable interest. It shows that the percentage of oxygen dissolved by iron in the liquid state does not exceed 0·21 per cent., and that above this the liquid separates into two melts. The lowering of the freezing-point of iron is, in fact, only about 8°. The solid solubility of oxygen has not been exactly determined, but is estimated to be about 0·05 per cent. It will be seen from the diagram that oxygen is practically without effect on the δ, γ, and α change points.

The authors have been able to prepare ingots of pure iron-oxygen alloys, to roll them, and to subject them to various physical tests. The maximum weight of ingot was about 450 gm. They have found that the low-oxygen iron (0·08 per cent.) can be rolled perfectly easily both hot and cold, and that the rolled material is ductile in a tensile test. It is, however, very brittle under notched bar impact tests; this may be due to the large grain size of the material which is facilitated by the purity of the metal in other respects. Ordinary normalising methods do not produce a small grain size in low-oxygen iron. With increasing oxide content there is a marked decrease in ductility. The authors have also carburised and case-hardened samples of iron of low and high oxygen contents, and have found that this can be done without difficulty. They conclude that the oxide particles appear to be practically unaffected by the process. This is certainly a matter of some importance.

Part III. of the research is contributed by Mr. Rooney, and deals with the estimation of oxygen in "pure iron." He has found that the best temperature for complete reduction of the oxide by hydrogen is between 1150° and 1200° C., and suggests that the problem of reducing it depends not so much on the facility with which the hydrogen can penetrate into the metal as on the ease with which the water-vapour formed can escape. Another method used is that described by Oberhoffer and Keil, which consists in heating millings with a proportion of an alloy of antimony (40 per cent.) and tin (60 per cent.), and collecting and weighing the water-vapour produced in the ordinary way. These two methods gave substantially identical results. H. C. H. C.

Seasonal Changes in Shell-fish.

MR. H. MUNRO FOX, in a paper published in the Proceedings of the Royal Society (B, No. 671) in January last, entitled "Lunar Periodicity in Reproduction," refers to vol. ii. of the Philosophical Transactions, published March 1667, by Henry Oldenburg, Sec.R.S., wherein, at p. 419, may be found the following question, forming one of a series comprised under the heading, "Inquiries for Suratte, and other parts of the East-Indies"—"Whether those shell-fishes, that are in these parts plump and in season at the Full Moon, and lean and out of season at the New, are found to have contrary Constitutions in the East-Indies."

Modern zoology, through Mr. Fox, has answered this old-time question in detail; but there are some considerations that may be suitably advanced. As is well known, in the earliest years of the Royal Society, the promotion of knowledge by means of a "correspondency" with diligent persons in various parts of the world was encouraged in every possible way. Lists of inquiries were drawn up by fellows of the Society, who were severally charged with the task of reporting such information as could be secured, or see that it was communicated to Oldenburg. That zealous officer, with the prevision for which he was famous, took care that such inquiries should be placed on record in the Transactions, irrespective of replies. He desired to have "confirmations of the truth of these things from several hands before they be relyed on."

As regards the particular question which engaged Mr. Fox's attention, it would appear that it was answered—though in the briefest fashion—by the person to whom the whole body of inquiries was addressed, none other than Sir Philiberto Vernatti, then resident in Batavia. Sprat's "History of the Royal Society" was published in 1667, and in this he prints the "inquiries" for the East Indies, but goes further than Oldenburg, inasmuch as he supplies the original answers. It is matter for conjecture how it came about that Oldenburg only furnished the questions, whilst Sprat gave these, supplemented by the replies. The reply respecting shell-fishes was, "I find it soe here by Experience at Batavia, in oysters and crabs."

It is interesting to record the origin of the East India inquiries. So early as 1664, Vernatti had sent over a wooden case containing an "East-India present." The case was opened at a meeting of the Society, and at the same time the answers returned by Vernatti to inquiries which he had previously received (recommended to him by Sir Robert Moray), were read and ordered to be registered. Further, Moray was desired to write a letter of thanks for the double gift, and to take care that an order be drawn up for moving the East India Company by favour of the Lord Berkeley, that they would please to recommend such kind of inquiries to their correspondents in the East Indies, and take care of the conveyance of what should be committed to them for the Society.

Afterwards, Dr. Wilkins was desired to speak to his lordship, that he would, in the name of the Royal Society, move the committee of the Company to give their interest. Wilkins reported later that the Lord Berkeley had spoken with several of the Company and certain "very inquisitive men, now in town," who were thought able to answer queries. If unable, these queries would be put before their resident factors. Whereupon, Dr. Wilkins, Dr. Croune, and Mr. Colwall were charged with the prosecution of the matter. As an issue, towards the end of the year Dr. Wilkins acquainted the Society that some of the East India Company were ready to attend them, and it was ordered that the president (Viscount Brouncker), and as many of the committee for correspondence as conveniently could, should give them a meeting forthwith at some place to be agreed upon. Following these engagements, we hear no more of the undertakings until the year 1667.

In general connexion with the foregoing, it may be mentioned that in the Philosophical Transactions for 1669 a paper is printed entitled "On the odd turn of certain snails contrary to the solar turn."

Tests for Scholarships and Promotion.

IN the United States there are no scholarships offered to children passing from the primary to the secondary schools, and, except perhaps in New York, only a comparatively small number of scholarships are awarded for entrance into the universities. Moreover, the bases on which they are awarded are extremely numerous. These facts had to be borne in mind at the joint discussion of the Sections of Education and Psychology of the British Association at Toronto, in which eminent American men of science participated.

In Great Britain, on the other hand, scholarships are awarded on the results of tests, and it is therefore essential to investigate how well these tests—whatever their nature—are performing their function. At present, the most critical age is about eleven, when the child sits for the secondary school scholarship, but, as pointed out by Dr. Cyril Burt, the age of seven or eight, when children are promoted from the Infants Department to the Senior Department, is a neglected but crucial stage in the child's life, as his subsequent success in the scholarship examination may depend upon it. In fact, tests for scholarships to secondary schools are merely a particular case of tests for promotion. Thus, there may be tests for departmental promotion, for class promotion, for scholarships to secondary schools, trade schools, or even to the universities. Both in Germany and in the U.S.A. classes for gifted children have been formed, and it is argued that if psychological clinics are needed for selecting dull and stupid children, *a fortiori*, they are an essential prerequisite in selecting gifted children.

Prof. Whipple (U.S.A.) brought forward evidence to show that the selection of a class of bright children merely from those recommended by the teachers would have resulted in ignoring half of the brightest boys and girls; further, that pupils properly selected can accomplish two years' work in one, even under a mediocre teacher. Teachers are also likely to select for such work a number of pupils that ought not to be selected and that are certain to fail in the attempt to double their pace. It may be observed, in passing, that this question of determining what should be the acceleration of each pupil requires some caution, but, at present, it is rather beyond the province of this résumé.

Prof. Buckingham (U.S.A.) also showed that mental tests will prophesy with respect to the most capable children a rather high minimum of scholastic success, and will do this with high trustworthiness. This result was also shown to hold for university students, and it may be remarked that intelligence testing of university students has become fairly general in the United States. Reference was made to investigations carried out at Syracuse University, where a gross correlation of plus 0·60 between academic success and intelligence was obtained. It was found, however, that the relationship is closer among the more capable students and not so close among the less capable, so that, for the purpose of selecting successful students, the intelligence test is more trustworthy than the correlation coefficient, depressed as it is by the presence of the duller students, would lead us to expect.

There is now a mass of evidence obtained by independent investigators in different countries which enables an unprejudiced observer to draw certain broad conclusions, namely: (1) There exist at present certain mental scales of proved use in assessing the innate mental ability of pupils. (2) Even the judgments of capable teachers, when made independently of such tests, are often untrustworthy and unjust. When these two conclusions are generally accepted, it seems difficult to avoid the further conclusion either that teachers should be trained in the use of such tests, or else that all cases involving the assessment of the mental ability of an individual should be decided by qualified testers. Further, there is considerable evidence that children of high intelligence are also quite preponderantly children of good growth rates, sound health, good social spirit, industrious, ambitious, eager, and possessed of initiative and resourcefulness, who would unquestionably profit by reasonable educational acceleration and enrichment.

It is well worth while, however, to investigate what should be the *reasonable* educational acceleration of each pupil. It is often said that it takes all sorts to make a world, and objection may be made to the draining of the brightest children from a class; and further, that if the pupils in a class were as alike as peas in a bag, that class would be dull indeed. But let it not be forgotten that the advocate of such a procedure would be as rare and impractical as his antithesis who would abolish examinations altogether, even assuming that a psychologist could somewhere be found able to select such a class. The common-sense point of view would seem to be that of most teachers, namely, that reasonable acceleration is desirable, which means that more suitable treatment should be given to the brightest as well as to the dullest pupils for their own sakes, for the sake of the teachers, and for the sake of the community.

Vegetative Propagation in the Tropics.

PROBABLY no scientific problem more urgently needs attention in tropical agriculture than the establishment of standard yielding plantations from selected plants by methods of vegetative propagation. The commercial demand in the centres of distribution is always for a regular supply of produce of standard quality, and so long as the grower collects his crop from a plantation of chance selected seedlings of almost infinite variety, this commercial requirement cannot be met. With increasing competition, as supplies of tropical products arrive from new centres, as the development of tropical areas proceeds apace, it was certain that this point would gradually be grasped, and that, if cultural conditions permitted, the produce from vegetative propagation of standard varieties would oust the original variable supply from seedling stock, just as in Europe, and now in the United States, vegetative propagation is the rule over all the vast acreage supplying the world's needs in table fruit.

It is very instructive, for example, to read in Prof. Hendrick's book, "The Peaches of New York," that isolated experiments upon grafting peaches were made in the United States from 1770 onwards, largely upon the repeated insistence of English colleagues on the value of the method; but in the period between 1825 and 1860 the value of the uniform product thus available was realised, nurseries seemed to spring from the ground by magic, and whilst before that there were millions of peach trees grown and few varieties recognised, in that period some 400 varieties were carefully propagated and described, a number that by 1900 had reached a thousand.

British tropical possessions are as yet ill provided with the large and well-staffed experimental plantations, on which alone the experimental work can be carried out that is necessary before vegetative propagation can be resorted to upon a large scale with a staple crop. Unless provision is made for the experimental work and for the demonstration of the new methods to the staffs of the commercial plantations, a few decades may see British tropical products ousted from the markets by the more trustworthy produce from tropical areas developed by other nationalities upon more scientific lines. In this connexion the Ceylon journal, *The Tropical Agriculturist* (vol. 72, No. 2), undoubtedly does good service to British tropical agriculture by republishing the papers by A. A. M. N. Keuchenius upon the vegetative propagation of tea and by Dr. P. J. S. Cramer upon grafting in coffee culture, the latter being translated from the Dutch by H. L. Ludowyk, librarian to the Ceylon Department of Agriculture. Thus is made available to English readers the valuable scientific work carried out under Government auspices in the Dutch East Indies.

The Java experiments upon vegetative propagation of the tea-plant were the natural corollary of the selection experiments carried out upon this plant at the Government's Cinchona Plantations. Keuchenius describes no less than thirteen different methods of vegetative propagation which were tried, but whilst only 2 per cent. of cuttings were successfully propagated by placing branches, stripped of leaves, in moist sand, with crown-grafting an average of 74 per cent. of successes was obtained, with rectangular patch-budding about 87 per cent., and by upright stem layering, in which roots were encouraged to arise above a ring in the bark by enclosing this region of the stem in soil held in a split bamboo, more than 50 per cent. were successful.

Dr. Cramer's paper will well repay perusal because of its very general survey of vegetative propagation in the tropics, reference being made to the work at the experiment stations at Lampongs and at Bangelan, which has been directed to exploit the possibilities of vegetative propagation of all the principal industrial plants. He points out that the first experiments upon grafting coffee were initiated in order to protect the highly valued Arabian coffee from eelworm attacks by placing them upon a resistant root system. He describes also the Klein Getas graft as it was known in Central Java, a valuable hybrid plant which its owner, Dessauvagie, of course, failed to reproduce from seed; it was perpetuated by the success of the owner of the Klein Getas estate in propagating it by grafting from, in the first place, two branches which he succeeded in obtaining from the original tree. It is unfortunate that in the translated account the word graft-hybrid, which has quite a different connotation in recent literature, is frequently used for this propagation of a valuable hybrid, obtained by ordinary pollination means, by the ordinary method of grafting.

Dr. Cramer has been advocating grafting in the case of coffee since 1907 in order to arrest the deterioration that was manifest in Liberian coffee; he has had an uphill task, but since 1914, when he took charge of the Coffee Experiment Station at Bangelan, he has been able to carry out his experimental plans upon an extensive scale. He has now no less than 250 small plots, grafted from separate selected parent trees, 139 larger plots in which selected grafted forms are being developed to provide scion shoots for larger hectare plots; 30 hectare plots with 1100-1600 plants on each plot were planted at the end of 1918–19. Records of the plots are being kept, the grafted plants yielding a regular harvest since the trees came into bearing. On a number of old plantations, trees have been cut back and grafted, the plantations thus being rendered a good deal more productive and the yield, of course, more uniform. This work has shown that the process of transformation to a grafted plantation can be carried out gradually, and the loss resulting from the crop one has to forgo is thus minimised.

University and Educational Intelligence.

ABERDEEN.—The following appointments to assistantships have been made: F. W. F. Hendry (agricultural chemistry); R. G. J. Fraser (natural philosophy); W. Niven (pathology); W. J. Ironside (veterinary hygiene).

CAMBRIDGE.—Prof. A. C. Seward, Master of Downing College, has entered into office as Vice-Chancellor of the University for the Academic Year 1924-5.

DURHAM.—Sir William Bragg, Fullerian professor of chemistry in the Royal Institution, opened the new College of Pure Science in October 1. After the ceremony, Sir William Bragg was given the honorary degree of D.C.L.

Applications are invited by Armstrong College for an adviser in agricultural mycology and an advisory agricultural economist. A British University degree is necessary; also some agricultural experience. Applications (10 in number) should be sent not later than October 20 to the Registrar, Armstrong College, Newcastle-upon-Tyne.

GLASGOW.—The King, on the recommendation of the Secretary for Scotland, has approved the appointment of Dr. H. H. Dixon, professor of botany in the University of Dublin, to be Regius professor of botany in the University in succession to Prof. F. O. Bower.

LONDON.—The following four candidates have been nominated for the by-election for the parliamentary representative of the University of London, in succession to the late Sir Sydney Russell-Wells: Sir John Rose Bradford (Conservative); Dr. F. G. Bushnell (Labour); Dr. E. G. Graham Little (Independent); Prof. A. F. Pollard (Liberal). The first three are medical men, while Prof. Pollard is professor of English history at University College. Polling, which will be by voting paper only, will take place on October 13-17, closing at 5 P.M. on the latter date. The results will probably be announced at 11 A.M. on October 18.

The vacancy in the Senate of the University caused by the death of Sir Sydney Russell Wells will be filled at the meeting of Convocation to be held on Tuesday next, October 14. There are three candidates, namely, Prof. Dame Helen Gwynne-Vaughan; Sir Josiah Stamp, the distinguished economist and statistician; and Dr. J. S. Bridges. Dame Helen Gwynne-Vaughan is professor of botany at Birkbeck College, and has for many years taken an active part in the work of the University. The XXth Century Society of London Graduates is strongly supporting her candidature, and has issued a circular, a copy of which has reached us, describing her many public services, and referring to her important contributions to botanical science. In her election address, Dame Helen remarks, in stating the main principles for which she stands:—"Situated at the heart of the Empire and in touch with unrivalled materials for research, the University has imperial responsibilities which can only be met by greatly increased provision for postgraduate study; places should be available not only for our own graduates

but for students from all parts of the Empire and beyond. This is especially the case in the Faculty of Science. The part which scientific workers can play in the life and government of the nation, and the value of their services are as yet insufficiently recognised. It should be the function of the University to educate the public in an appreciation of scientific discovery and to extend our knowledge by facilitating research."

A course of three free public lectures on "La Douleur, au point de vue des fonctions affectives et perceptives" will be delivered, in French, by Prof. H. Piéron, of the Sorbonne, at Bedford College for Women, on October 21, 22, and 24 at 5.15. No tickets will be necessary.

MANCHESTER.—An assistant lecturer in electrical engineering is required at the Municipal College of Technology. Forms of application may be had from the Registrar. They should be returned by, at latest, October 22.

APPLICATIONS are invited for two lectureships in pure mathematics, one senior and another, in the University of Cape Town. Ability to teach actuarial mathematics and statistics is desirable. Applications, in duplicate, must be sent (upon a special form) to reach the Secretary, office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2, by, at latest, October 28.

THE eleventh centenary of the University of Pavia is to be celebrated in May next, for it was in A.D. 825 that the University was made the centre for higher education in Lombardy. Part of the celebration will be the raising of a monument to Lanfranc, a member of the University, who afterwards became Primate of England; scientific workers will, however, more readily associate with the University the name of Volta, the distinguished professor of natural philosophy.

DR. M. C. RAYNER, joint author with her husband, Prof. W. Neilson-Jones, of "A Text-book of Plant Biology," and also author of a number of botanical papers, has been awarded a Theresa Seessel research fellowship for the year 1924–25 in the Graduate School of Yale University, for work in botany. The fellowship, which is of the value of 1500 dollars, was founded "to promote original research in biological studies," and involves residence in New Haven during the college year, October-June.

THE University of Bombay has received a gift of Government paper worth nearly 50,000*l.* for the endowment of university scholarships for Mohammedan students going to foreign countries for higher studies in medicine, philology, ancient history, Arabic, architecture, town-planning, and technological and industrial subjects, and in preparation for Government service. An interesting feature of the scheme is that the scholarships are to be considered as advances repayable with interest when the scholar obtains regular remunerative employment. The donors are the trustees of the educational trusts founded by Sir Currimbhoy Ebrahim and his daughter. We regret to record that Sir Currimbhoy, who has for many years been associated as a generous patron with numerous educational enterprises, especially Moslem schools, colleges, and orphanages, and the Institute of Science of Bombay, died on September 26 at the age of eighty-five, shortly after the announcement of this munificent gift.

Early Science at the Royal Society.

October 12, 1663. This meeting being appointed for the farther consideration of experiments fit to entertain his majesty with, several of the members present were charged to be curators of the following experiments—Mr. Boyle, To try the magnetical experiment of altering the polarity by repercussing the extremes of an iron rod, made red-hot and refrigerated; and also of destroying all the magnetism by striking it in the middle. To destroy the attractive virtue in a load-stone by heating it red-hot, whilst it keeps the directive virtue.—Dr. Ent, To bring in the anatomy of a lobster and an oister.—Mr. Hooke [among other experiments], To make an artificial eye; to try the casting of a picture on a wall in a light room; to make a hygroscope with the beard of a wild oat.

1664. It was mentioned that there was an instrument made for measuring the swiftness of the wind; and that Sir William Petty had observed that a wind-mill with an ordinary blast of wind turned so often, as to go after the rate of about sixty miles in an hour. He was desired to take care of these experiments, and to observe particularly the difference of the velocity of forced and of free wind; and to bring in an account of all.

October 14, 1663. Mr. Clayton related, that a lady having lost one of her teeth, a porter was hired, one of whose teeth was drawn by La Roche, and put into her mouth where it grew firm. This was confirmed by Dr. Whistler, who related that the same La Roche hit on this art accidentally, having once drawn out the wrong tooth of a countryman; for which mistake La Roche finding him extremely enraged, he told him that if he would have a little patience, he would put the tooth in, and make it grow again as firm as before; which he accordingly did, setting in the good tooth and putting the gums carefully about it.

October 15, 1662. Sir Robert Moray gave an account of his majesty's favour to the society, in declaring his pleasure, that no patent should pass for any philosophical or mechanical invention, but what was first put to the examination of the society.—He mentioned likewise a proposal likely to be speedily referred to them, of making iron with sea-coal.

October 16, 1661. Six balls of a like size were produced, one of lignum vitæ, one of stone, two of tin, and two of lead; to try their different velocity of sinking in water, or falling down in the air.—Dr. Pope made his experiment of breaking pebbles with his hand; which succeeded very well.—Mr. Greatoricks tried what he could do in the compression of water; but being not then prepared, he did not succeed.—Sir Robert Moray acquainted the society that he and Sir Paul Neile had kissed the king's hand, in the society's name; and he was desired by them to return their most humble thanks to his majesty for the reference, which he was pleased to grant of their petition; and for the favour and honour done them of offering himself to be entered one of their society.

October 17, 1666. Mr. Povey mentioned, that there was a certain moving sand in Suffolk, that was driven from one part of the county to the other, and had laid waste great parcels of land, and dam'd up a river; a full description of which he promised to procure with the first convenience.

1667. The experiment appointed for the next meeting, upon the suggestion of Mr. Hooke, was that of making the blood of an animal pass from one side to the other out of the vena arteriosa into the aorta, without passing through the lungs. Dr. Lower and Mr. Hooke were desired to take care of this.

Societies and Academies.

PARIS.

Academy of Sciences, September 8.—M. Emile Roux in the chair.—René **Maire**: The alpine vegetation of the Morocco Grand Atlas. Hooker and Ball, in 1871, after a rapid survey, expressed the view that there was no true alpine flora in the Great Atlas. The author's explorations in 1921, 1922 and 1923, in collaboration with MM. R. de Litardière and Humbert, show that there is a clearly characterised alpine flora, commencing on the north side at 3000 to 3150 metres, a short description of which is given.—Constant **Lurquin**: Quetelet's binomial law of probability.—E. **Brylinski**: Michelson's experiment.—A. **Brodsky**: The corresponding temperatures of solid bodies.—Georges **Brus**: The oxidation of nopinene by permanganate. The yield of nopinic acid is increased by vigorous agitation of the non-miscible liquids, and by treatment during the process with a rapid current of carbon dioxide.—J. **Barthoux**: The massifs of Djebilet and of Rehamna (Morocco).—MM. **Rothé, Lacoste, Bois,** Mlle. **Dammann** and Mme. **Hée**. Comparison between the explosion of Oppau and that of May 23 at Courtine.—E. **Ducloux**: Attenuation of the virulence of *Bacillus anthracis* (spore-bearing form). The immunising power of the attenuated bacillus. The attenuation was produced by a series of cultivations in a broth made from fish liver (*Gadus merlangus*). Experiments on the immunity produced in sheep are described.—G. **Guittonneau**: The production of ammonia from amino nitrogen by the microsiphonideæ of the soil. The results of experiments with glycocoll, alanine, leucine and tyrosine are given. There is generally some conversion into ammonia by the action of organisms, but the amino acids are not attacked with equal facility.—S. **Metalnikov**: The heredity of acquired immunity. Description of experiments on the grubs of *Galleria mellonella*. These were chosen because the eggs develop away from the mother, and six to eight generations can be produced in one year. Evidence of the transmission of acquired immunity against the cholera organism M was obtained.

ROME.

Royal Academy of the Lincei, May 30.—V. Volterra in the chair.—F. **Severi**: Reduction of the principles of relativity to their logical and psychological elements.—A. **Piutti** and E. **Boggio-Lera**: Rare gases from volcanic exhalations.—L. **Sabbatani**: New pharmacological observations with sulphur. By simultaneous injection of sulphur and a reagent such as lead phosphate or silver iodide into the animal organism, it is shown that hydrogen sulphide is liberated immediately the sulphur comes into contact with the tissues.—Mario **Ferrari**: Datolite from Monte Campotréra (Reggio Emilia).—Teresa **Nocca**: Datolite from Rigollo (Province of Parma). Chemical and morphological data are given for this mineral.—Silvio **Ranzi**: Closure of the otocysts, development of the ductus endolymphaticus (or recessus labyrinthi, or aquæductus vestibuli) and its homology in the series of the vertebrates.—E. **Giglio-Tos**: Curious forecasts verified by experimental embryology.—G. **Fadda** and I. **Sciacchitano**: The polar groove and the fertilisation membrane in the egg of the sea-urchin.

SYDNEY.

Royal Society of New South Wales, August 6.—Dr. C. Anderson, president, in the chair.—W. R. **Browne**: Notes on the physiography and geology of the Upper Hunter River. The evolution of the valleys of the Upper Hunter and its tributaries is discussed. The main determining factors have been differential hardness of the rocks and submeridional Tertiary faulting, which has brought the soft coal-measure rocks against the harder Carboniferous strata. The upper portion of the Upper Hunter east of the fault-plane is probably a superimposed stream brought into being as a result of very extensive flows of Tertiary basalt, now largely eroded over a surface of Carboniferous rocks. The faulting may be continuous from about Werris Creek as far south as Branxton.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 10, No. 7, July).—J. H. **Breasted**: Historical tradition and oriental research. Archæological discoveries in Egypt and the East generally point to the fact that Greek science and civilisation owe much to the Egyptians. Greek legends have, in many cases, been found to be based on fact. The nucleus of tradition is part of the surviving evidence of man's early history.—G. Y. **Rainich**: Second note: electrodynamics in the general relativity theory.—S. K. **Allison** and William **Duane**: The reflection of characteristic bromine X-radiation by a crystal of potassium bromide. Radiation from a molybdenum target tube operated at 63,000 volts was reflected from the 100 planes of the crystal. Evidence was obtained of the characteristic bromine K-series peaks.—Alfred W. **Simon**: Quantitative theory of the influence electrostatic generator. The treatment is mathematical and, it is claimed, can be applied to any static machine.—P. A. **Ross**: Scattered X-rays. Molybdenum K-lines scattered at various angles from heavy as well as light elements show shifts which are stated to be in accord with Compton's quantum theory of scattering.—George P. **Merrill**: (1) On a stony meteorite from Anthony, Harper County, Kansas, and a recently found meteoric iron from Mejillones, Chile. The former is classified as a grey chrondite much discoloured by secondary oxidation. The latter may be the original Mejillones mass which fell in 1874. (2) A meteoric iron from Four Corners, San Juan County, New Mexico. It is a breccia composed of fragments of a fine-grained pyroxenic rock with excess of coarse granular nickel-iron as cementing material.—M. T. **Bogert** and F. H. **Bergeim**: The constitution of Columbia yellow (chloramine yellow).—Cecilia H. **Payne**: A synopsis of the ionisation potentials of the elements.—Clyde E. **Keeler**: The inheritance of a retinal abnormality in white mice. Sections of the eyes of some albino mice showed the absence of visual cells, external nuclear layer and external molecular layers. The defect seems to be inherited as a Mendelian recessive.—W. R. **Miles**: Action of dilute alcohol on human subjects. Ethyl alcohol in dilute solution, broadly speaking, increases pulse-rate, metabolism and skin temperature, and decreases reflex irritability and efficiency generally. Accuracy is more affected than speed. The effect of alcohol appears to be related directly to the average concentration of alcohol found in the urine (samples taken at 30 min. intervals).

Official Publications Received.

Reprint and Circular Series of the National Research Council. No. 55: Science and Business. By John J. Carty. Pp. 8. (Washington, D.C.: National Academy of Sciences.) 20 cents.

Bulletin of the American Museum of Natural History. Vol. 51, Arts. 2 and 3: Further Evidence on the Structure of the Eosuchia; On the Classification of the Reptiles. By R. Brown. Pp. 39-76. Vol. 51, Art. 4: The Position of the "Sparassodonts"; with Notes on the Relationships and History of the Marsupialia. By Horace Elmer Wood. Pp. 77-101. (New York.)

Straits Settlements. Annual Report on the Raffles Museum and Library for the Year 1923. By C. Boden Kloss. Pp. 18. (Singapore.)

Memoirs of the Department of Agriculture in India. Botanical Series, Vol. 13, No. 1: Studies in Indian Tobaccos. No. 4: Parthenocarpy and Parthenogenesis in two Varieties of *Nicotiana Tabacum* L., var. *Cuba* and var. *Mirodato*, by Gabrielle L. C. Howard and Kashi Ram; No. 5: The Inheritance of Characters in *Nicotiana rustica* L., by Gabrielle L. C. Howard. Pp. 37+15 plates. Botanical Series, Vol. 13, No. 3: Studies in Indian Fibre Plants. No. 3: On the Inheritance of Characters in *Hibiscus Sabdariffa* L. By Albert Howard and Gabrielle L. C. Howard. Pp. 47-85+6 plates. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co.) 2 rupees; 3s., each.

Memoirs of the Indian Meteorological Department. Vol. 23, Part 8: Frequency of heavy Rain in India. By Sir Gilbert T. Walker. Pp. 413-524. (Calcutta: Government Printing Office.) 3.14 rupees; 5s. 10*d*.

Conseil Permanent International pour l'Exploration de la Mer. Publications de Circonstance, No. 83: On *Chiridothea Entomon* (L.) in the Southern and Western Baltic. By Anton Fr. Bruun. Pp. 12. Publications de Circonstance, No. 84: Standard Net for Plankton Collections. By C. H. Ostenfeld and P. Jespersen. Pp. 16. Rapports et Procès-Verbaux, Vol. 33: Times of Entering of the Atlantic Salmon (*Salmo salar* L.) in the Rivers. By Osc. Nordquist. Pp. 58+2 plates. Bulletin Hydrographique pour les années 1920, 1921, 1922, 1923. Publié par le Bureau du Conseil, avec l'assistance de Martin Knudsen. Pp. 103. (Copenhague: A. F. Høst et fils.)

Proceedings of the South London Entomological and Natural History Society, 1923-24. Pp. xix+153. (London: Hibernia Chambers, London Bridge.) 10*s*.

University of Iowa Studies in Child Welfare. Vol. 3, No. 1: A Study of Hereditary and Environmental Factors determining a variable Character; Defective and Freak Venation in the Parasitic Wasp *Habrobracon juglandis* (Ashm.). By Dr. P. W. Whiting. Pp. 80. (Iowa City.) 1.25 dollars.

The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report, East Malling Research Station, 1st January 1923 to 31st December 1923. Pp. 138+10 plates. (East Malling, Kent.) 3*s*.

Birkbeck College (University of London). The Calendar for the Year 1924-25. Pp. 193. (London: Bream's Buildings.)

Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1923-24. (Cmd. 2223.) Pp. iv+139. (London: H.M. Stationery Office.) 3*s*. net.

Bulletin of the Imperial Agricultural Experiment Station in Japan. Vol. 3, No. 1: Über die Verdaulichkeit der Futtermittel bei Hühnern. Von T. Katayama. Pp. 78+2 Tafeln. (Nishigahara, Tokio.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, Antigua, 1922-23. Pp. iv+22. Report on the Agricultural Department, St. Kitts-Nevis, 1922-23. Pp. iv+49. (Barbados.) 6*d*. each.

National Union of Scientific Workers. On the Encouragement of Fundamental Research: Report of the Research Committee presented to the Council of the National Union of Scientific Workers on 26th January 1924, and adopted. Pp. 23. (London: 25 Victoria Street.) 6*d*.

The University of Colorado Studies. Vol. 13, No. 2: Mollusca of Colorado, Utah, Montana, Idaho and Wyoming. By Prof. Junius Henderson. Pp. 65-223. (Boulder, Colo.) 1 dollar.

The British Mycological Society Transactions. Edited by Carleton Rea and J. Ramsbottom. Vol. 10, Parts 1 and 2, September 26. Pp. 128+9 plates. (London: Cambridge University Press.) 15*s*. net.

New Zealand: Dominion Museum. Bulletin No. 10: Maori Religion and Mythology, being an Account of the Cosmogony, Anthropogeny, Religious Beliefs and Rites, Magic and Folk Lore of the Maori Folk of New Zealand. By Elsdon Best. Section 1. Pp. iii+264+6 plates. (Wellington, N.Z.: W. A. G. Skinner.)

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 2, No. 16: The O-type Stars. By J. S. Plaskett. Pp. 287-358+3 plates. (Ottawa: F. A. Acland.)

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 60: Statistics of Private High Schools and Academies, 1921-22. Prepared under the Direction of Frank M. Phillips. Pp. 53. (Washington: Government Printing Office.) 10 cents.

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1923. Pp. ii+14. (Livingstonia.)

Department of Public Instruction: Technical Education Branch, New South Wales. Technological Museum: Annual Report for Year ended 31st December 1923. Pp. 4. (Sydney: Alfred J. Kent.)

Government of Madras: Law (Education) Department. Administration Report of the Madras Government Museum and the Connemara Public Library for 1923-24. Pp. 6. (Madras.)

Proceedings of the Royal Society of Victoria. Vol. 36 (New Series), Part 2, 14th August. Pp. 83-264+plates 7-18. (Melbourne.)

Fourteenth Report on the Sarawak Museum, 1915-1923. By Dr. E. Mjoberg. Pp. ii+102. (Sarawak: Government Printing Office.)

Ministry of Agriculture and Fisheries. Report of Proceedings under the Salmon and Freshwater Fisheries Acts, etc., etc., for the Years 1922 and 1923. Pp. 54. (London: H.M. Stationery Office.) 3*s*. net.

Diary of Societies.

SATURDAY, OCTOBER 11.

BRITISH PSYCHOLOGICAL SOCIETY (at University College), at 3.—Prof. C. Spearman: The New Psychology of "Shape" (Gestalt).—S. A. Hamid: Some Factors of Effectiveness in Mental ("Intelligence") Tests.

MONDAY, OCTOBER 13.

MEDICAL SOCIETY OF LONDON (Annual General Meeting), at 8.—Dr. E. M. Callender: Medical Memories.

TUESDAY, OCTOBER 14.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Indicator Diagrams and Lessons therefrom.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall), at 7.—H. A. Stirzaker: Safety Valves.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—M. O. Dell: The Pyrenees.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—Major R. B. S. Sewell: Recent Work of R.I.M.S. *Investigator* and Problems of Tropical Oceanography.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Automobile Club), at 8.—Dr. W. R. Ormandy: Research (Presidential Address).

WEDNESDAY, OCTOBER 15.

ROYAL METEOROLOGICAL SOCIETY, at 5.—L. F. Richardson: (*a*) The Brown Corona and the Diameters of Particles; (*b*) Photometric Observations on Clouds and Clear Skies.—L. J. Sutton: Notes on "Haboobs."

BRITISH SOCIETY OF MASTER GLASS-PAINTERS (at 6 Queen Square, W.C.), at 6.30.—Sir Charles Nicholson: Architecture and Stained Glass.

ROYAL MICROSCOPICAL SOCIETY, at 8.—J. E. Barnard and J. Smiles: A Comparison Ultra-Microscope.—Dr. R. S. Clay and T. H. Court: Some Developments of the Hooke Microscope.—Prof. A. G. Hornyold: Mounting with Venetian Turpentine.—J. Smiles and J. E. Barnard: The Correction of High Aperture Dark-Ground Illuminators.

INSTITUTE OF CHEMISTRY (London Section), at 8.—The Position of Chemistry (Various Papers).

THURSDAY, OCTOBER 16.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Dr. Rohrbach: Large All-metal Seaplanes.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—J. S. Jones: Hygrometry for Deep Mines.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Prof. T. P. Nunn: The Educational Philosophy of Gentile.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Pictorial Group Meeting.

CHEMICAL SOCIETY, at 8.—R. Lessing and A. L. Banks: The Influence of Catalysts on Carbonisation.—R. G. W. Norrish and Dr. E. K. Rideal: The Photosensitive Formation of Water from its Elements in the Presence of Chlorine.—J. Kenyon, H. Phillips, and H. G. Turley: Investigations on the Dependence of Rotatory Power on Chemical Constitution. Part XXIV. Further Experiments on the Walden Inversion.—Dr. F. L. Pyman and E. Stanley: The Directive Influence of Substituents in the Glyoxaline Nucleus on Substitution in the Benzene Nucleus of Phenylglyoxalines—the Nitration of 2-phenylglyoxaline and its Carboxylic Acids.

ROYAL SOCIETY OF MEDICINE, at 9.30.—Dr. W. T. Grenfell: Medicine in a Corner of the Empire.

FRIDAY, OCTOBER 17.

SOCIETY OF MEDICAL OFFICERS OF HEALTH (Annual General Meeting) (at 1 Upper Montague Street, W.C.), at 4.30.—Dr. R. A. Lyster: Idealism in Public Health.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Anatomy and Malformations of the Heart—(1) Specimens illustrating the Evolution of the Human Heart.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—T. Thorne Baker: The Telegraphy of Photographs by Wire and Wireless.

JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—R. P. Howgrave-Graham: High Voltage Electric Oscillations.

ROYAL GEOGRAPHICAL SOCIETY (AND ALPINE CLUB) (at Albert Hall), at 8.30.—Gen. Bruce, Col. Norton, Capt. G. Bruce, and Mr. Odell: The Mount Everest Expedition.

SATURDAY, OCTOBER 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Sir Archibald E. Garrod: Harveian Oration.

PHYSIOLOGICAL SOCIETY (at Guy's Hospital).

BIOCHEMICAL SOCIETY (at Cambridge).

PUBLIC LECTURES.

SATURDAY, OCTOBER 11.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—R. P. G. Denman: The Development of Modern Radio Communication.

MONDAY, OCTOBER 13.

UNIVERSITY COLLEGE, at 5.30.—Prof. E. W. Scripture: Researches on Speech and Song.

WEDNESDAY, OCTOBER 15.

UNIVERSITY COLLEGE, at 5.30.—Dr. E. A. Baker: The Use of Libraries.

THURSDAY, OCTOBER 16.

KING'S COLLEGE, at 5.30.—Prof. H. Wieland: Organic Radicals (in English).

FRIDAY, OCTOBER 17.

KING'S COLLEGE, at 5.30.—Prof. H. Wieland: Theory of Oxidation Processes (in English).

SATURDAY, OCTOBER 18.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Dewey: Cornish Scenery and its Causes.