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## Statistics in Administration.

A LARGE amount of work has been done in developing statistical methods on the scientific side, and it is natural for any one interested in science to hope that all this work may be utilised in commerce and industry. There are signs that such a movement has started, and it would be unfortunate indeed if those responsible in practical affairs fail to take advantage of the improved statistical machinery now available.

There are, admittedly, many difficulties in the way of introducing into any business a new type of investigation, and, even when these are overcome, we are aware that much of the statistical work of business is, and must be, mere tabulation—a dull form of accountancy that ends before the interesting process of analysis, investigation, and interpretation begins. In some of this tabulation, the form in which results have to appear is dictated by Act of Parliament, so we are deprived of using any ingenuity in arranging the figures. This is always regrettable to any one really caring about the subject, for though tabulation at its worst is about as dull as anything can be, it is made by skilful hands the first and by no means the least important element in any complete statistical investigation. Here we reach the beginning of things : the statistician may have specific problems to solve and may be able to start the preliminary work as he likes ; he can then feel most happy about his results, and he has the best chance of making those incidental discoveries which are interesting in all scientific work and often very valuable in statistical work in business. But he does not often have such a chance : over and over again some sort of statistical tabulation has been going on, and expense or delay puts rearrangement outside the realm of practical politics. The problem is then : " What is the best we can make of figures in the particular form ? "

Here, and in other cases, the trained man has the best chance of drawing useful conclusions, but it would be wrong to expect any statistician unfamiliar with a particular business to find out as much from statistics as would be possible if he knew a business well : ignorance of a business may lead to mistakes which experience instinctively avoids. Here possibly we see the fear, so far as it exists, of the professional statistician : and in a sense some fear, or at any rate some hesitancy, is right ; but the answer is not that the trained man should be avoided because he may make a mistake when called in to examine statistics of a business with which he is unfamiliar, but that in any business where statistical work is essential, a trained man should be on the staff. In some businesses trained men are employed as a matter of course : no respectable life assurance company would, for example, dream of conducting its business without having an actuary to examine and advise.

One part of statistical work often wanted in business is called by the fairly descriptive name of "cost accounting." In its simplest form it is merely the setting out of the cost of production of an article, but in many cases the problem is of much complexity, and in some ways it involves methods and principles like those adopted by an actuary in ascertaining the periodic payment necessary to meet a more or less complicated benefit. It seems, from this point of view, a little strange that this work should have fallen to the accountant rather than to the actuary, but both professions are trained to some extent in statistical work, and accountants, being auditors or on the staff for other purposes, are more readily available and have, at any rate, a superficial knowledge of the particular business.

It happens occasionally in practical work that a new process or a change in procedure or manufacture is suggested, and it is thought worth while to make a trial of the process. Any single trial may be a failure and yet the process may be an improvement on the old: the proportion of failures may be less. A success may depend on the combination of a number of causes. A trial may, however, be an expensive matter. The trained statistician who has studied those awkward problems of small samples will alone be able to read the answer correctly and to judge properly from a few experiments whether the proposed reform is worthy of adoption. Much of the statistical work done in biology at Rothamsted under Mr. R. A. Fisher is necessarily based on small samples, and the original work by "Student" in *Biometrika* seems to indicate a field of work on small samples in a practical business.

Generally speaking, however, the statistical work we have in mind would be of wider scope. It is only possible to judge of the success of each part of a business by investigation, and in many instances a study of a simple kind can tell a good deal, but if there is interlocking, if incidental profits are thrown up or if an apparent loss can be afforded in one part of the business because it is always associated with a large profit elsewhere, then the work may assume a troublesome complexity. We should anticipate that a well-trained practical statistician with a "roving commission" over all the figures produced in a business would save his salary over and over again.

We may now consider what training is available for the more highly skilled statistical work. Probably the most advanced school is that of University College, London, where Prof. Karl Pearson and his assistants and pupils have done so much original research both theoretical and practical. Then there are some other colleges of the University of London teaching the subject, sometimes, however, from a rather special point of view, *e.g.* at the London School of Economics. There are also opportunities for study at Cambridge and elsewhere, and there is a comparatively newly constituted school under Prof. E. T. Whittaker at the University of Edinburgh. In the United States the subject is taught fairly generally in some form or another, but, judging from the books published, it is sometimes only dealt with superficially. Apart from the universities, probably the best places to learn the subject—and for certain businesses the schools, if they can be so called, are probably as good as any—are the Institute of Actuaries and the Institute of Chartered Accountants. To a certain extent, this remark also applies, of course, to the other accounting bodies and the Faculty of Actuaries, but to a lesser extent because the membership and the influence of these bodies are less. Many accountants would probably have difficulty in following much of the modern research work in statistics, owing to its mathematical nature, but, if we may judge by their examinations and transactions, actuaries should have no real difficulty in this respect.

Possibly the simplest way of improving statistical work in a business where little has yet been done is to appoint to the staff some one who has studied statistics theoretically, and can be encouraged to learn as much as possible of the business. Afterwards some of the younger members of the staff who do not, when appointed, possess the necessary qualifications, might be encouraged to acquire them, much as insurance offices and banks encourage members of their staffs to study theoretically the subjects with which they deal practically in their daily work.

## Some Problems of the Oil Age.

*American Petroleum: Supply and Demand.* A Report to the Board of Directors of the American Petroleum Institute by a Committee of Eleven Members of the Board. Pp. xiv+269. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 15*s*. net.

IT is generally recognised to-day that there are few commodities the failure of which to appear in the world's markets would cause more inconvenience than that of petroleum oil, which either as a fuel or as a lubricant is a vital necessity to many services of transport and production, apart from its still considerable use in many countries for lighting and heating.

The oil age, which began five and twenty years ago with the coming of the internal combustion engine, will probably endure for a considerable period, until

Nature and man in co-operation develop other means of power production. Nevertheless, authorities agree that the exhaustion of oil is proceeding far more rapidly than any known possibility of replacement. Men of science are only at the beginning of their investigations as to whether Nature is replenishing her stores of oil or not. It is true that there is a deep-rooted belief amongst practical oil men, based on empiricism rather than upon science, that lower down in the earth large supplies may lie, as yet only dreamt of in oil philosophy. Some support of this view is derived from the fact that the early primitive oil-wells were all shallow, and that even in 1861 Col. Drake in Pennsylvania struck oil at 69 feet.

At the present time, much oil comes from wells of 2000 to 3000 feet, and occasionally deeper. Oil technologists are not unnaturally beginning to talk of putting the drill down to oil sands at 5000 feet, whenever and wherever the prospect of a sufficient and remunerative supply may justify such a course. Oil will also be worked in due season to a far greater extent than at present from shales and other oil-bearing materials, which exist in large quantities in many other countries besides America. This latter source of supply may conceivably meet the oil needs of the world long after natural oil is wholly or nearly exhausted. It is not practicable, however, to say definitely long beforehand when a particular deposit will be ripe for commercial exploitation, since this depends on the richness of the material in oil and by-products as well as upon cost of working and the degree of competition of natural petroleum.

In Great Britain the consumption of oil products, including supplies to ships' bunkers, exceeds five and a half million tons per annum, nearly all imported. The United States uses about twenty times as much oil as we do with a population three times as great as ours. But America is at one and the same time a producing, importing, refining, consuming, and exporting country in the matter of oil. Many countries depend in whole or part upon the U.S.A. for supplies of lighting and lubricating oils and motor spirit. A possible extension of imports of oil into U.S.A. may occur, but will she maintain or restrict her exports? British supplies of oil products are drawn principally from Persia, America, the Dutch East Indies, and Mexico, with some production from Scottish shale and a modest amount of benzol from coal.

There is no need further to labour the point that the most advantageous use of Nature's stores of oil, coal, and water-power is and must always be of wide-spread interest. We may welcome, therefore, the thought-stimulating report recently published by the American Petroleum Institute on the prospects of oil supply and demand over the next fifty years in the United States. Though the report is limited geographically, the estimation which it contains of general factors likely to affect oil production and consumption is of wider than purely American interest. The report is in the main a business document on an economic basis and is only incidentally scientific and technical. It is no disparagement of so complex a survey to say that reality is likely to differ from estimate in many cases, seeing that numerous disturbing though occasionally counter-balancing factors must arise. Even general tendencies may be deflected and greatly modified. Nevertheless, the report is valuable from its wide outlook notwithstanding the geographical limitation which has been imposed.

A previous American oil estimate, known as the "White-Steburger," dealt, some six years ago, with the potential oil reserves of the whole world, but on a geological rather than an economic basis. That survey created some uneasiness from the suggestion that American fields were rapidly nearing exhaustion and that supplies in other countries, of natural petroleum at any rate, would probably meet requirements only for some sixty years or so. Men of practical experience in the oil trade in America and elsewhere were able to allay anxiety to a considerable extent by pointing out, on the basis of past experience, that the oil industry usually does much better in actual output than might be prognosticated by prudent men of science working upon uncertain data and necessarily incomplete investigation. The increase since then of production in California and Texas and in fields outside of the United States has confirmed the impression that the "White-Steburger" estimate was an extremely conservative one.

The 1925 report bears the signatures of eleven men of recognised standing in the American oil industry. No attempt is made therein to frame an estimate of the potential quantity of oil in lands in the U.S.A. "not yet proved," which are classified as "areas within which oil-fields may be found," of a total area exceeding eleven hundred million acres. The "present producing area" is about two million acres and "proved undeveloped areas" amount to another million acres approximately. The number of American wells now producing is about 300,000, yielding an average of one ton a day each. The world's production of crude oil in the last sixty years has practically doubled itself every ten years or so, until it has reached an annual total of about 136,000,000 tons, of which the American proportion is about 70 per cent.

The oil trade, however, has now reached a point at which a steady rather than a sensational progression may be expected. It is stated in the estimates in the report that existing proved fields may yield by normal flowing and pumping some six or seven years' supply, but it is anticipated that, if prices and products should justify a more complete draining of wells by water-flooding, mining, and other intensive methods, some five times that quantity may be obtainable in addition. Oil is expected to be found also at lower depths than those of existing wells, and eventually will be largely produced from shale, coal, and lignite. The liquid possibilities of these three classes of solids run into billions of tons and might last for centuries. From one source or another, with adjustments as between oil, coal, and water-power, and allowing for economies in methods of production and utilisation, America expects to meet its oil needs for many years beyond the period of fifty covered by the report.

On the side of utilisation, the expectation is that motor facilities will be still more widely used. The report visualises "a nation on wheels." The present "saturation point for automobiles" is estimated at 27,000,000, *i.e.* one family, one automobile. The power production of cars in one year is 3,600,000. The U.S.A. population and number of families in 1950 are estimated each at about 50 per cent. increase over the figures of 1920, and the number of automotive engines, including motor cycles and aeroplanes, is calculated to reach by 1950 a total of nearly forty-five millions, as compared with some fourteen or fifteen millions in 1924. "Some figures!" But wonderful things happen where oil is concerned. It must not be supposed that the demand for motor spirit will be proportionately increased. A far lower rate of consumption is expected with improved engines. Britishers will compare the American 1924 figures with their own modest total of less than one and a half million motor vehicles, and will also hope for engines that will give them an additional mileage per gallon. In addition to the early adoption of more economical automotive engines of the types that use motor spirit, an increase is also looked for in the case of Diesel engines, in which heavy residual oil is used on a more economical basis than for steam raising. British marine engineers have recognised the advantages of the Diesel engine in many types of ships, but they have faith in steam turbines for very high-powered vessels. On this side of the Atlantic improvements of the turbine are anticipated, which incidentally may economise fuel consumption whether oil or coal.

Intensive drilling and refining, and the use of geophysical apparatus and other means as an aid to oil exploration, are well known to technologists generally, who are also watching progress in various methods of extraction of oil from coal and the further development of electricity by water-power. These matters are suggestively touched upon in the American report, but in some cases very sketchily. We are not carried very far when we are told that developments "may prove the possibility" of the utilisation of finely powdered coal or coke either by itself or in suspension in fuel oil, fed to motors. The data of actual tests under working conditions are needed to indicate whether real progress has recently been made or not.

Our brief study of this subject on the whole confirms the expectation of many good authorities that the replenishment of the world's cruse of oil will be maintained for some considerable time to come.

## The Inspiration of Chemistry.

*Three Centuries of Chemistry: Phases in the Growth of a Science.* By Prof. Irvine Masson. Pp. vi+191. (London: Ernest Benn, Ltd., 1925.) 10*s*. 6*d*. net.

IT is a common complaint that men of science do not write readable books. We hear it especially to-day among those who, despite their complete ignorance of science, are known as "well-educated" people. The complaint is levelled in particular against representatives of physics and chemistry. Naturalists, it is said, have done better; even Darwin's great original contributions to science were issued in the stream of general literature and were intelligible to the non-scientific. The complaint about physicists and chemists has recently grown louder, because educated people know it is in physics and chemistry that great things are happening. It is exasperating to feel that vast horizons of new knowledge are being opened out, that something like a revolution of thought is taking place, and yet not to be able to get some clear notion of it. True, some excellent simple expositions of this new science have been written. They fail, however, because there is nothing to which they can be linked in the mind of a reader with no knowledge of the elementary principles of the old science. Unless he has something like a vista of the chief facts and the chief stages in the development of our knowledge of physics and chemistry, how hopeless it is to give him any conception of what the new knowledge really means!

We, who live in science, are apt to say that we are not answerable for this grievous popular ignorance. No doubt that is true to some extent, perhaps to a large extent. But it is not wholly true. Leaving aside the influence which our world has exercised on school-science, there remains the question whether we have not failed in another direction.

It must almost inevitably happen that the days of formal education leave a man very defective in knowledge—it may be almost blankly ignorant—of some department of human thought. Consider, for example, the young men coming to-day to study in our universities in numbers, without any training in the language, literature, and history of Greece and Rome—without even any knowledge of "roots" to unmask the pretensions of words like catalysis and karyokinesis, or to elucidate even the simplest Latin etymology. These people, if they have mental health, will in time seek to cover their intellectual part-nakedness; and they will not find it difficult. They may forgo the grind of grammar and forgo even the learning of the languages altogether, and yet obtain, in an easy-chair, some abiding comprehension of what Greece and Rome meant to humanity and some share of the gifts they have bequeathed us.

Let us suppose the commoner case of our middle-aged or elderly contemporaries, who left school and college after an education that excluded any enlightenment in physics and chemistry. What can be done with them? What are they likely to have done for themselves to repair the omission? Nothing. But let us not be too hard on them. It is not easy to pursue laboratory work in the leisure and precincts of the average home. Attempts to do this were made at another great period of chemical upheaval. Even Dr. Johnson himself discovered a "love of chymistry which never forsook him." Boswell unfortunately is very meagre in this part of his story. He observed in Johnson's library "an apparatus for chymical experiments," and records coldly that at the age of seventy-four years the Doctor "attended some experiments that were made by a physician at Salisbury on the new kinds of air." Of what Johnson himself did, the only occurrence that seems to have roused his biographer to animation and detailed record was the great man's purchase of an ounce of oil of vitriol, for a penny instead of an expected three-halfpence. There is evidence that other men of letters of the time were striving to keep in touch with chemistry. Francis Horner, a picked man of the first Edinburgh Reviewers, attempted experiments at home, but, after some misfortunes, had to conclude regretfully that it was scarcely practicable to distil sulphuric acid in a living-room.

If we have to admit that the difficulties of amateur self-education in chemistry after school and college days reduce us to the exclusion of experiments, there seems to be only one hope left. It is that we can tell the story of the science in simple yet vivid terms, with a clear design and sequence, with vast and carefully considered elimination, with accurately timed and adjusted stress, with human regard to the discoverers as men as well as intellectual regard to their own and other men's philosophies; and we must do it with the best literary skill we can command.

It is this that Prof. Masson has attempted to do in the book before us. He has succeeded so well that a reviewer's difficulty is here to moderate duly his terms of praise. Let it be said, then, at once, that the author's equipment for his task is by no means wholly of his own making. Looking into his ancestry, a Mendelian could probably explain the exact amounts and proportions of scientific and literary talent which Prof. Masson has had as a free gift. Then there are Scotland, Australia, and the great metropolis, and great teachers that all count for a good deal. With this equipment Dr. Masson has attempted "to show the very broad foundations that were provided to sustain the present structure of science, and to what manner of men and circumstances we owe the laying and the consolidation of those bases (Chaps. i.-iv.). Next, to show in action the application of this process to chemistry, and the issue of a dominant motive which has given continuity to the whole subsequent trend of the science (Chap. v.). The ensuing phase in chemistry displays the long struggle between the new mode of thought and the ancient philosophy, ending with the eighteenth century in a solution of the central problem and a final ousting of medievalism (Chaps. vi.-x.). In the next phase the key-problem has taken on a deeper meaning, and the arrival of its successful interpretation is set forth as we know it to-day, while note is taken of the oncoming of still another era (Chap. ix.)."

The result is a book which deserves and will doubtless obtain the widest currency, for it is a work both of literature and science. It will hold the attention of "those who do not understand the technicalities of chemistry and physics, but are interested either in the evolution of modern thought or in applied logic." Above all, it will be useful to those who call themselves chemists. A real danger of these days of high pressure in chemical studies is that we may grow narrow intellectually. It would be a calamity if, in the intensive cultivation of our plots of science, we were to grow heedless of the general drift of our work. It is not at all inconceivable that science might otherwise lead to the sort of distortions and extravagances that the world has suffered, in the realms of thought and education, from the illiberality of humanists and super-humanists.

The length to which this notice has already extended precludes any comment or criticism on detail. The object has been only to indicate the high importance of the task which Prof. Masson set himself and to convey the reviewer's impression that it has been achieved with very remarkable success. He would heartily congratulate Prof. Masson on having made a most valuable and scholarly addition to general literature in the name of science.

A. Smithells.

## The Maori of Olden Times.

*New Zealand Board of Science and Art.* Manual No. 4: *The Maori as he was; a Brief Account of Maori Life as it was in Pre-European Days.* By Elsdon Best. Pp. xv+280. (Wellington, N.Z.: Dominion Museum, 1924.) n.p.

MR. ELSDON BEST has written for the New Zealand Board of Missions an account of the Maori when they first became known to Europeans, interpreted in the light of later knowledge, and by his own familiar acquaintance with native customs and ideas. The work covers the whole range of Maori anthropology.

Two distinct physical types of native are said to occur. One, long-headed and prognathous, approaches the Fijian; the other, with broader head and orthognathous, is the common Polynesian. The hair is commonly black and waved, though frizzled hair is sometimes seen.

In a chapter on traditional history, Mr. Best very briefly reviews the native accounts of the peopling of New Zealand, especially those preserved by tribes on the east coast of North Island. These traditions indicate an original Polynesian migration from lands in the west called Uru and Irihia. Following Conder and Percy Smith, it is suggested that Uru is the Biblical Ur, and that Irihia is connected with Sanskrit and Dravidian words for rice—*vrihi* and *ari*. These are mere guesses. A summary is given of the more important Polynesian voyages which led to the settlement of New Zealand.

The mythology and folklore form an interesting chapter in which the author stresses the Maori genius for personification and its application to natural phenomena, and the evolution of such myths as that of the green-stone, fabulous monsters and fairies. A summary of the religious ideas of the Maori follows, a subject with which Mr. Best has dealt more fully elsewhere (cf. NATURE, June 9, 1923, p. 790).

Like other Polynesians, the Maori were communists in social custom. The proceedings of the family, clan and tribe, and the power and prestige of the chief, were closely influenced and controlled by public opinion, and the same force maintained law and order and regulated the relations of the three classes of the community, chiefs, commoners and slaves. The Maori was a sociable being, living in village communities. He took his meals in the open, and was hospitable and fond of conversation, story-telling and amusement. Men only engaged in occupations in which *tapu* was prominent, such as house-building, canoe-making, crop-planting and the obtaining of food. In the last work women helped, especially in gathering shell-fish, but they were more especially engaged in preparing and cooking food and in the manipulation of the flax fibres and the manufacture of clothing, plaited mats and baskets. This chapter concludes with a brief account of birth, marriage and funeral customs. Birth, death and exhumation were marked by much ritual; marriage and burial by less. An infant underwent the rites of *tohi* and *pure*. The first is described by Mr. Best as a kind of baptism, the second as a greeting to the child. Betrothal, sometimes of infants, might be arranged before marriage, and marriage by capture sometimes took place. The dead were buried in a sitting position, but the remains were exhumed with much ceremony after a few years, and finally conveyed to a distant cave or hollow tree.

Mr. Best's chapter on the arts of life occupies half the book, and is exceedingly well illustrated. He describes the arts of pleasure, war, agriculture, woodcraft, textiles, clothing and ornaments, habitations and fishing. The Maori's implements were crude and primitive. Fire was produced by rubbing one stick on another. There was no loom; the cloaks of flax fibre were made by interlaced and tied threads, not by true weaving. Adzes were of stone, agricultural implements of wood. A simple drill was used, and Mr. Best figures a tree-felling machine on the principle of the Roman *ballista*. House-building is described in detail. The Maori was an expert carver. His decorative art is remarkable for curvilinear forms, in contrast to the commoner rectilinear designs of Polynesia. Tattooing was practised by both sexes; by men on face and body, by women usually on the lips and chin only.

Fishing and bird-trapping provided the chief animal food of the Maori. The dog and rat were articles of luxury. Fishing nets and traps were of great variety. Some, of immense size, astonished early European visitors.

Mr. Best has produced a very useful little book, which will inform and interest the traveller or the tourist, and provide a useful syllabus for the serious student of Maori thought and custom. There is a short bibliography, a good index, and more than 130 illustrations of persons and objects.

S. H. RAY.

## Fundamentalism and Science.

*The Relation between Science and Theology: How to Think about It.* By C. Stuart Gager. Pp. vi+87. (Chicago and London: The Open Court Publishing Co., 1925.) 1 dollar.

THIS book is a very useful piece of anti-Fundamentalist polemic. The underlying causes of that strange reaction have been diagnosed by Prof.

Kirsopp Lake, of Harvard, as "general but imperfect education and democratic government." If that be so, perhaps the United States will not be the only country to be affected by this strange recrudescence of superstition.

No doubt Fundamentalism will one day meet its Voltaire; but he will be neither man of science nor philosopher, but theologian. It is only the theologian who can appreciate the imbecility of this revival. Properly speaking, it is not a revival, for the Fundamentalist has forgotten much of the theological thought of the past, while learning little of that of the present.

Mr. Stuart Gager has attempted to disseminate a certain amount of light where it is badly needed by delivering popular lectures, and by publishing their substance in the present volume. The book is to be commended for two reasons: (1) The author has taken a good deal of trouble to understand and to explain what is really meant by literary criticism of the Bible, and (2), he has concentrated not upon the *results* of the natural sciences, but upon the *method* of science in general. Thus, he has gone the right way to work; for no one who has a clear grasp of the methods and results either of the literary and historical criticism of the Bible, or of the natural sciences, would find Fundamentalism intellectually or emotionally attractive. It is really a question of whether a person is or is not capable of following an argument, or weighing evidence, or indeed used to any kind of systematic thinking. Neither Mr. Gager nor an angel from heaven could do much for people whose limitations or obstinacy preclude them from availing themselves of his help.

Mr. Gager's title—"The Relation between Science and Theology," not "Science and Religion"—indicates that he understands the nature of the problem; for the quarrel is not between the incommensurables, science and religion, but between science and some particular theory about our religion, its origin and its meaning. In justice to theology it has to be remembered that Fundamentalist theology, unlike that, for example, of St. Thomas Aquinas, is intellectually not respectable.

The general reader will not find this book any less valuable on account of its somewhat naïve metaphysical point of view. For example, the conceptions of *cause* and *change*, though they play some part in the argument, are not subjected to any radical analysis. But Mr. Gager is not writing for students of Kant, who rarely succumb to the seductions of Fundamentalism.

Mr. Gager's work, simple, straightforward, and well informed, deserves a wide circulation; especially perhaps in some parts of the United States, where theological thought seems to be more remote from the precincts of reason than it is, at present, in Great Britain.

J. C. HARDWICK.

## Our Bookshelf.

*Le Cerveau et le cœur.* Par Prof. G. Fano. Traduit de l'italien par G. Caputo. (Nouvelle Collection scientifique.) Pp. vii+211. (Paris: Félix Alcan, 1925.) 10 francs.

THERE is often a baldness of statement necessary in contributions to scientific journals which freezes the interest of a sympathetic but non-scientific reader. This is partly because wide general conclusions cannot be appended to each single published contribution. At intervals, however, during a career of scientific work, it is possible for some to touch on the deeper aspect of things. Prof. Fano has published a series of lectures in book form which can be recommended to the biologist and to the general reader, to one for an attempt to probe the *causa causans* of his science, to the other for its exposition of scientific methods and of the trend of physiology.

In introducing the author to the French public, Prof. Gley says, "Fano n'est pas seulement un expérimentateur: c'est un penseur." The truth of this statement is made evident to the reader as he finds described and discussed various problems of research, each in turn. The properties of living matter are dealt with at some length and from many aspects. Probably more satisfying to the majority of readers are later chapters, which describe the effects of ablating at different levels the higher nerve centres of the tortoise, *Emys Europœa*, and the interpretation of the results in relation to the will and to inhibition. A parallel deduction might have been made from the similar work of Sherrington and of Magnus on higher animals.

Other chapters recapitulate the earlier work of the author on electrical responses of cardiac muscle and his observations on the heart of the chick, and give insight into his minute technique. The book is a useful collation, in a language other than Italian, of the researches and philosophical views of this Italian *doyen*, and takes a worthy place among its fellows in the "Nouvelle Collection scientifique" Alcan.

*Air Ministry: Meteorological Office. The Observatories' Year Book*, 1922: Comprising the Results obtained from Autographic Records and Eye Observations at the Observatories at Aberdeen, Eskdalemuir, Cahirciveen (Valencia Observatory), Richmond (Kew Observatory), and Benson; in continuation of the former British Meteorological and Magnetic Year Book, Parts 3 and 4. (M.O. 259.) Pp. 337 + 6 plates. (London: H.M. Stationery Office, 1925.) 63*s*. net.

THE elements dealt with in the volume are barometric pressure, air temperature, humidity, rainfall, sunshine, wind velocity and direction, cloud and general weather. Records are tabulated for each hour. Details are given of the exposure and surroundings of the different instruments, and photographs show generally the position of the instruments. The work consists mostly of tabular results closely printed. Much information is afforded for minute study on various subjects of meteorological importance. At Eskdalemuir the diurnal variation in the components of magnetic force on quiet and disturbed days is given. The variation of the several components is shown by diagram for the year and for the several seasons, and average results are given for the years 1911–1921; special attention is also given to seismology. At Valencia the outstanding features for 1922 are said to be the cold weather of April, the prolonged low temperature, practically continuous from the middle of June to the beginning of November, and the small rainfall of October and November. At each of the four observatories (omitting Benson) the highest temperature during the year occurred at the end of May, and the minimum about the middle of January; at Kew the minimum reading was repeated on April 2, the highest and lowest readings occurring within 52 days of each other. The largest hourly measurement of rain at Aberdeen, Eskdalemuir, and Kew occurs in day hours between 8 A.M. and 5 P.M.; at Valencia it occurs between 1 and 2 A.M. The smallest hourly measurements occur between 7 A.M. and 1 P.M., except at Eskdalemuir, where it occurs from 8 to 9 P.M.

*The Hidden Zoo.* By Leslie G. Mainland. (The Broadcast Library.) Pp. 205+8 plates. (London: Hodder and Stoughton, Ltd., 1925.) 3*s.* 6*d.* net.

Mr. Mainland is already well known as a delightful writer of popular articles on the Zoo, and this book is no less fascinating and amusing than his earlier volumes. In this collection of articles the author takes us behind the scenes at the Zoo and tells of the worries and anxieties of keepers and staff, and of the amusing and sometimes disastrous escapades of some of the animals. Its chief merit is, perhaps, the revelation which it makes of the large amount of careful and valuable research work which has to be done and is done by the staff in their endeavours to secure the best possible results for the animals in captivity, and the care which is constantly exercised in order to obtain the most natural conditions, consistent with confinement, for their charges. The nature of the correct food, the times at which it should be given, the rearing of the young, even the breeding of suitable foster mothers for the young of birds, are all matters demanding close observation and experiment. Mr. Mainland tells how these problems have been faced and solved. The book is charmingly written in humorous vein and is eminently suitable for reading to children. Yet the professional zoologist will find in it all sorts of odd facts of natural history of real scientific interest.

*Food and Health.* By Prof. R. H. A. Plimmer and Violet G. Plimmer. Pp. vi+64. (London: Longmans, Green and Co., 1925.) Paper cover, 2*s.* net. Cloth, 3*s.* 6*d.* net. Food Chart, 3*d.*

The purpose of this little book is to explain to a lay public the principles on which a complete dietary is based, directing special attention to the errors which are commonly made in the selection of foods for human consumption. The central idea is comprised in a "square meal" expressed diagrammatically; the carbohydrates and fats or the "fuel foods," together with water and salts, constitute a central circle, whilst the four corners to form the square are filled up by proteins of good biological value and foods containing one of the three vitamins respectively. A coloured diagram shows at a glance both those foods which should be included in a complete dietary and also those of similar nature which should be either excluded or, if included, should not form the staple representatives of their class. The authors consider that the average dietary contains too little vitamin B to balance the remaining constituents, especially the carbohydrates. The work is written in a pleasant style and can be read with profit not only by the public, to whom it is more immediately addressed, but also by those whose training should enable them to express an authoritative opinion on the subject.

*Úvod do Chemie Radioaktivních Látek.* By Dr. A. S. Russell. Translated by Prof. Dr. A. Šimek. Pp. x+116. (Brno: A. Piša, 1925.) Kč 20.

Although it was Bohemia which supplied the classical pitchblende in which radium was first detected, the Czech scientific literature does not possess any volume on radio-activity. Dr. A. Šimek, who is professor of physical chemistry at the Masaryk University of Brno, has, therefore, translated Dr. A. S. Russell's "Introduction to the Chemistry of Radio-active Substances" into Czech for the benefit of his students.

In his preface the translator points out that to write a treatise on a subject of this kind, the author must himself have conducted extensive original researches on the phenomena of radio-activity. This was one of the reasons for selecting Dr. Russell's text-book, which is also better adapted for translation than the more comprehensive treatises, since the latter would be in need of revision almost as soon as the translation was in the hands of the student.

The Czech edition closely follows the original work, but additions have been necessitated by the latest progress in this ever-expanding branch of physical chemistry. In his preface Dr. Šimek acknowledges the author's careful revision of the original English edition for the purpose of bringing the translation entirely up-to-date.

*Strength of Materials.* By Prof. Alfred P. Poorman. Pp. xi+313. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 15*s.* net.

There appears to be a large demand in the United States for good engineering text-books of a theoretical type but of rather elementary standard. According to the preface, the present work is intended ". . . for use in undergraduate courses in Mechanics . . ." and it might serve as a useful introduction to the subject in the junior classes of engineering schools in Great Britain. The ground covered is not extensive, being confined to a discussion of the more ordinary problems in the theory of beams, shafts, and columns. Combined stresses are only dealt with in a few very simple cases, and the amount of elastic theory given is decidedly meagre, even for an introductory work. A large number of practical examples to be worked by the student are distributed throughout the work, appearing at the end of almost every article. The book is, however, carefully written, and the various figures throughout the text have been admirably reproduced. The treatment of the subject matter follows orthodox lines, and two chapters in the later part of the book are devoted to special methods of solving problems on the deflexion of beams.

E. H. L.

## 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.*]

### An Ancient Wooden Structure at Ipswich.

IN the course of excavations—carried out by means of a grant from the Percy Sladen Memorial Fund—in the brickfield of Messrs. A. Bolton and Co., Ltd., in the northern portion of Ipswich, a discovery has been made of the remains of a wooden structure that may be of considerable antiquity. As is widely known, there are preserved, in places, in the sides of the small, dry valley where the brickfield is situated, two superimposed "floors," or occupation levels, in which a large number of flint implements, flakes, and hammer-stones, together with hearths, fragments of very coarse and primitive pottery (these were found at two sites only), mammalian and some human bones, have been discovered. The investigation of these "floors" has been conducted, at intervals, for the last fifteen years, and, during this period a very complete knowledge has been acquired, both of the type of specimens occurring at these levels, and also of the geological happenings since the time when these prehistoric remains were deposited in the valley.

The excavations that have been carried out this year were confined to the north-east part of the brickfield, and have exposed, in the small escarpment of the valley at this spot, the following deposits: (1) surface humus to 9 inches; (2) sandy, stony hill-wash to 8 feet, passing into (3) reddish sand, with small ferruginous concretions, often tubular in form, to 2 feet; (4) traces of Upper Floor resting unevenly upon (5) grey sand, to 2 feet, with (6) Lower Floor at base, resting unevenly upon (7) yellow sand. This yellow sand, upon which the lower floor rests, is found also on the south side of the valley, and, where containing water, has in it numerous roots of trees—*Pinus sylvestris*—that flourished, evidently, on the ancient land surface represented by the lower floor. It may be assumed that the sand was dry when these trees—which do not favour wet ground—were growing, and the preservation of their roots is almost certainly due to the present water-logged condition of the sand.

In the recent excavations a quantity of these roots were met with in the sand underlying the lower floor, and it was at this latter level that the remains of the wooden structure—now to be described—were found. As will be seen from Fig. 1, this consists of two short pieces of wood, of plank-like form, which overlap where they meet, and were placed with one of their longer edges buried superficially in, and more or less vertical to, the surface of the underlying sand. The "plank" nearest the observer is 2 feet 6 inches in greatest length, three-quarters of an inch in greatest thickness, and 8 inches in greatest width; while that farthest away from the observer is 1 foot 10 inches in greatest length, $1\frac{3}{4}$ inches in greatest thickness, and about 7 inches in greatest width.

These pieces of wood, which, by their characteristic form, were evidently split off a trunk of large size, are of oak, and exhibit, on one or other of their surfaces, clearly defined marks of cutting with some kind of axe. Behind these planks, that is, on the side farthest away from the observer, were piled a quantity of flints and other good-sized stones, and a row of (?) larch stakes, not set closely together—roughly pointed, and driven to a depth of about 1 foot into the underlying sand. These stakes—one of which can be seen in the photograph (Fig. 1)—have most of their upper portions missing, and were not inserted vertically, but inclined at an angle, with the sand surface, of about 45° towards the east: the apex of the angle formed by the intersection of the ends of the two planks (Fig. 1) pointing, approximately, to the north-west. Between the planks, and the supporting mass of stones, were found traces of clay in which were partially embedded numerous branches of (?) larch, and it is supposed that these branches, together with the missing upper portions of the stakes described, extended for some distance above the planks, and afforded a shelter from the sun or wind. The heap of stones farthest away from the observer (Fig. 1) was, unfortunately, moved before the photograph was taken, but occupied, originally, a position in close contiguity to, and about opposite the middle of, the "shelter," and, as among this heap there were found hammer-stones, one large, roughly-made *racloir*, numerous flakes, and some burnt flints, associated with blackened, carbonaceous sand, it seems that here was some sort of habitation where the manufacture of flint implements was carried on.

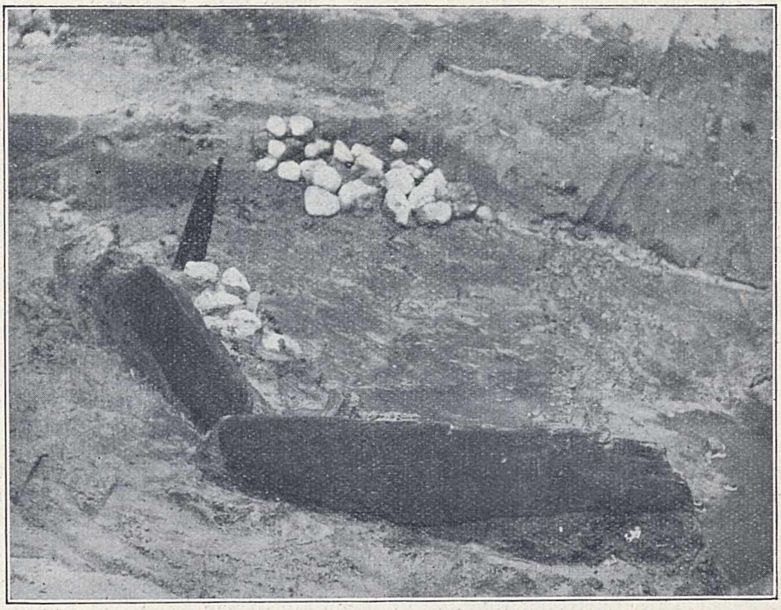

FIG. 1.—Remains of wooden structure *in situ* in the lower floor in Messrs. Bolton and Co.'s brickfield, Ipswich.

The artefacts mentioned are in every way comparable with others found in the lower floor in the immediately surrounding area and throughout the brickfield, and the wooden structure described was buried beneath (1) surface humus, 4 inches; (2) reddish sand with small ferruginous concretions, to 18 inches; (3) greyish sand, vaguely stratified, to 2 feet 6 inches; and (4) black, peaty sand, to 1 foot (this sand is evidently the lower part of layer 3). These strata appeared to be quite unbroken, and, with the exception of the humus, to be continued into the neighbouring escarpment, where the level at which the structure rested is covered by about 13 feet of deposits.

Fig. 2 shows the condition of the strata overlying the wooden structure before it was completely uncovered. As will be seen from Fig. 1, there was no trace of a continuation of the habitation to the east, and my present opinion is that it represents all that remains of a primitive shelter of some kind. But I admit, frankly, that I have never seen any structure of this kind before, and I have no wish to be in any way dogmatic as to its original form, or use.

The flint implements, together with a series of specimens made from non-flint rocks, found in the lower floor, were regarded by the late Prof. V. Commont, and other archæologists, among whom I am to be numbered, as referable to a phase of the Upper Mousterian, palæolithic, culture, but Prof. Henri Breuil, and several investigators, believe the specimens must be assigned to some early portion of the neolithic period. Further, though I have little doubt that the valley in which these ancient floors occur has been deepened since their occupation by man, and a considerable thickness of hill-washes of, apparently, different ages, deposited over these occupation levels, yet it is not, at present, possible to say with certainty to what particular time, after the deposition of the Upper Chalky Boulder Clay of the Ipswich district, these events are to be referred. The north-east portion of the brickfield where the wooden structure was found has been inhabited by rabbits for a very long period, and their activities have, in some cases, carried pieces of Roman bricks, and other objects, to a depth of many feet. The majority of the Roman remains of the area occurs, however, in, and just beneath, the surface soil, and though two small pieces (the presence of one of these may, probably, be accounted for by supposing it to have been thrown in with the material used to cover up the structure after discovery, so that it could be examined *in situ*, by other archæologists, before removal) of brick were found within a yard or two of the structure, and at a similar depth from the surface, I find it difficult to believe that the habitation itself is of Roman date, especially as the strata above it showed no signs of disturbance, as is so apparent in graves of this period in the high ground to the west.

The site where the structure was found is now completely water-logged, and there is no doubt that this condition accounts for the preservation of the wood, which, however, has had to be kept immersed in a suitable liquid to prevent its disintegration. This work has been undertaken by Mr. Guy Maynard, curator of Ipswich Museum, who also took the excellent photograph showing the structure *in situ*. About 15 yards to the west of where the discovery of the habitation was made, traces of what appeared to be another were found; only in this case a portion of one of the stakes, and some small branches, were alone preserved. The condition of the wood found, which, by experiments I have carried out, could, I believe, have been shaped by a sharp flint, and split off a trunk by means of wedges of stone, though, of such widely different antiquity, exhibits a similar appearance to many of the branches and other parts of trees found in the Cromer Forest Bed of Norfolk.

At a later date I hope to publish a fully illustrated and detailed account of this discovery.

J. REID MOIR.

One House,
Ipswich.

Lower part of Layer No. 2.

Layer No. 3.

Layer No. 4.

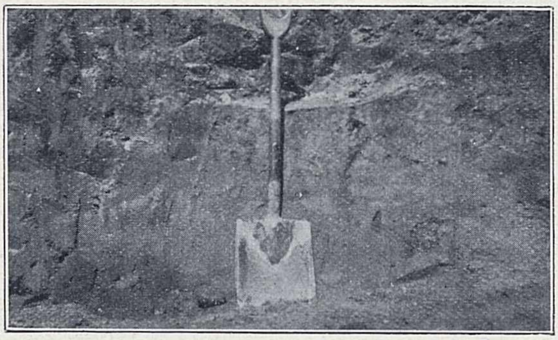

FIG. 2.—Section above wooden structure found in lower floor of Messrs. Bolton and Co.'s brickfield, Ipswich.

### The Solar Constant and Terrestrial Magnetism.

A LETTER in NATURE, November 28, p. 785, under the above title by Dr. G. C. Abbot, discusses a recent paper of mine in the *Proceedings of the Royal Society*. It refers to two of the subjects investigated in my paper, the 27-day interval, and the relation between corresponding daily values of $S$ (the solar constant), as published by Dr. Abbot, and of $C$, the international character figure, intended to supply a measure of magnetic disturbance. To take the second question first, Dr. Abbot's statement is as follows: "Dr. Chree does find indications of magnetic disturbance associated with low values of the solar constant. Inasmuch as higher solar constant values are generally associated with numerous sunspots and abundant magnetic disturbances, he thinks this paradoxical finding of low solar constants associated with magnetic disturbances is non-significant. On the contrary, it is exactly what we should expect . . . the passage of an individual sunspot group over the central meridian of the solar disc is almost always associated with decreased values of the solar constant, and doubtless frequently with terrestrial magnetic disturbances. Hence it is prevailingly with low rather than high solar constant values that individual magnetic disturbances will be found associated."

What I actually did was to take for each month of 1923 the 5 days of largest $S$ and the 5 days of smallest $S$. This supplied 60 days representative of high and 60 representative of low solar constant. Calling the representative day in either class $n$, I calculated from the De Bilt annual table the mean value of the magnetic character $C$ for day $n$ and the associated 4 subsequent days. The results were as follows, $A$ denoting the group in which $n$ was the representative day of high $S$, and $B$ the group in which $n$ was the representative day of low $S$.

VALUE OF $C$.

| Day. | $n$. | $n+1$. | $n+2$. | $n+3$. | $n+4$. |
|---|---|---|---|---|---|
| $A$ | 0·39 | 0·49 | 0·48 | 0·46 | 0·47 |
| $B$ | 0·50 | 0·51 | 0·57 | 0·60 | 0·55 |

The mean value of $C$ for 1923 was 0·48.

Dr. Abbot's explanation does not seem to me at all to fit the facts, even if for a moment we accepted them as exact physical data. What it should lead to would surely be a decided excess in $C$ in the day $n$ of group $B$ over the mean value for the year. Now the excess is only 0·02, and no one, I should think, who knows anything of magnetic character figures would accept this as significant. If any of the figures are significant, it is the low value of $C$ in day $n$ of group $A$, and the high values of $C$ on days $n+2$ and $n+3$ of group *B*. But on these figures Dr. Abbot's explanation seems to throw no light whatever.

The results did not encourage me at the time to prosecute the inquiry further. But in view of the weight naturally attaching to Dr. Abbot's views, I have now extended the investigation to 1921, 1922 and 1924, so as to cover the four years for which Dr. Abbot claims the highest accuracy in the values of *S*.

If the cause suggested by Dr. Abbot were sensible in 1923, the year of sunspot minimum, we should expect it to be conspicuous in the other three years, which had on the average a sunspot frequency more than three times as large. The results are given in the following table, *A* and *B* distinguishing the two groups of days of high and low solar constant as before. Instead, however, of the absolute values of *C*, I give in each case the algebraic difference from the corresponding mean from all days. Only 11 months were available for 1924, but as much weight has been allowed to this year as to the others. The mean character figure for the four years combined was 0·575.

VALUE OF *C*.

| | Day. | *n*. | *n*+1. | *n*+2. | *n*+3. | *n*+4. |
|---|---|---|---|---|---|---|
| *A* | 1921 | +0·05 | +0·10 | +0·03 | −0·05 | −0·03 |
| | 1922 | +0·05 | +0·05 | −0·02 | +0·02 | −0·05 |
| | 1923 | −0·09 | +0·01 | 0·00 | −0·02 | −0·01 |
| | 1924 | −0·02 | +0·08 | +0·12 | +0·02 | −0·05 |
| | Mean . | 0·00 | +0·06 | +0·03 | −0·01 | −0·035 |
| *B* | 1921 | +0·11 | +0·07 | +0·08 | +0·08 | −0·04 |
| | 1922 | +0·01 | −0·05 | 0·00 | 0·00 | 0·00 |
| | 1923 | +0·02 | +0·03 | +0·09 | +0·12 | +0·08 |
| | 1924 | −0·07 | +0·01 | +0·02 | +0·04 | +0·11 |
| | Mean . | +0·02 | +0·015 | +0·05 | +0·06 | +0·04 |

There is no column in which the higher value of *C* does not appear in the group *A* days in at least one year out of the four. In column *n* it occurs in group *A* in two years, and in column $n+1$ in three years. No column gives a larger mean value for *B* than column $n+1$ gives for *A*. If we omitted 1923, the year of sunspot minimum, the mean value of *C* in column *n* would be higher for group *A* than for group *B*. It will, I trust, be generally admitted that my attitude towards the data of 1923 has been justified.

There is nothing perhaps in the results now obtained incompatible with Dr. Abbot's belief as to the screening effect on ordinary solar radiation of sunspots when over the central meridian. If, however, such screening has a sensible effect on the solar constant, the apparent absence of a 27-day interval in the values of *S* becomes increasingly strange. If this interval had been prominent in even a few months of the four years, the method which I employed for detecting it should not have led, as it did, to a wholly negative result. Dr. Abbot's comments on this result leave me in doubt whether he believes that the 27-day interval, while not exhibited by *S* in recent years, was a true phenomenon in the earlier years, *e.g.* 1915, when he recognised it. If the phenomenon were real, we should have expected it to be shown the more clearly the more accurate the observations. In the case of magnetic data, it has shown no tendency to become less prominent since 1915. Perhaps I may say frankly that one of my reasons for investigating the matter was that I felt that my assurance that the apparent day-to-day fluctuations in *S* represented real fluctuations in the sun would be materially strengthened if they exhibited the 27-day interval clearly.

C. CHREE.

December 11.

**Passivity, Catalytic Action, and other Phenomena.**

THE writer's view of the passivity of chromium, manganese, iron, cobalt and nickel (NATURE, March 28, 1925, 115, p. 455) may now be extended and correlated with the recent work of H. S. Taylor (*Proc. Roy. Soc.*, 1925, A, 108, p. 105) and of E. F. Armstrong and T. P. Hilditch (*ibid.*, p. 111) on catalytic action at the surface of nickel, with that of J. Heyrovský (*Rec. trav. chim.*, 1925, 44, p. 499) on overvoltage, and with that of T. M. Lowry on the nature of chemical action. This view is based on Bohr's distribution of electrons within the atom. It supposes that in the elements mentioned the number of electrons in the outermost orbit is "ideally" between one and two, and is therefore either one or two, and that in consequence the atoms of such elements can never be electrically neutral in the same sense as atoms of sodium or of zinc. The experimental evidence favours calling the state with one electron in the outer orbit passive, and that with two electrons in the outer orbit active. The difference in potential between the two states of each of these metals is about 1 volt.

This Jekyll and Hyde explanation of passivity appears to differ *in toto* from the ordinary view which ascribes passivity to a protective film. It leads to a simple explanation of the non-corrosion of stainless steel. It is known that stainless steel is electrochemically nobler than copper. Now I find that both chromium and iron when passive lie between copper and bismuth in their susceptibility of being attacked by acids, although when active they are more reactive than cadmium. I find also that passive chromium and passive iron are closer in reactivity than are active chromium and active iron. I am less sure, although I have some experimental evidence in favour, that both iron and chromium when in true solution in a second metal become passive. It is known that chromium and iron are in solid solution in stainless steel. Each therefore may be regarded as passifying the other. It follows from what has been said that stainless steel should act like a nearly homogeneous metal which is nobler than copper, and this is what it is known to do.

It is known that some of the metals of the palladium and platinum groups and of the metals with "coloured ions," titanium, vanadium, chromium, manganese, iron, cobalt, nickel, copper, niobium, molybdenum, tungsten and uranium differ remarkably from other metals in their power of adsorbing certain gases and catalysing gaseous reactions. If the physicists will grant that atoms of these metals may conduct an electron from one reacting molecule to another, it is possible from a chemist's point of view to relate adsorption and catalytic action with passivity.

(*a*) I regard the metals mentioned above as being potentially able to exist in both active and passive forms, one of which is stable; thus manganese and iron are normally in the active form, and nickel and platinum in the passive form.

(*b*) I think these metals are best able to adsorb gases and to act as catalysts when in the passive form.

(*c*) They adsorb, because of their property of never being electrically neutral, a molecule which is capable of exhibiting polarity, the negative part of the molecule being attracted to the outside and the positive to the inside of the atom.

(*d*) They catalyse a reaction between $A_2$ and B, where A represents an atom, and $A_2$ and B molecules, because of their potentiality of passing from the passive to the active form. This may occur when the outer orbit gains an electron from $A_2$ or B and the inner orbit expels one on to B or $A_2$ (as well as in the normal way by gaining an electron from an inner orbit) so that the reaction may go

$$A_2 + B \longrightarrow A_2^+ + B^- \longrightarrow A_2B,$$

or $A_2 \longrightarrow A + A$, followed by $A + B \longrightarrow AB$;

the active form of the catalysing atom then reverts to the passive, either spontaneously or as a result of either final reaction. In other words, my view is that the reaction takes place because the passage of an electron from $A_2$ to B activates both, and that the catalysing atom is the conductor of this electron.

An example will illustrate. When metallic cadmium is shaken with dilute sulphuric acid, some of its atoms expel electrons to form ions, and in so doing discharge hydrogen ions to form atoms of hydrogen on the metallic surface. The chemical activity of these atoms is a simple function of the reactivity of the cadmium. These atoms are known to combine very slowly with each other, and this is expressed by saying that cadmium has a high hydrogen overvoltage. If a little platinum, tungsten or molybdenum be deposited on the cadmium, combination of the atomic hydrogen proceeds rapidly, and these metals are said to have a very low overvoltage. The view expressed in (*d*) shows how this occurs, and explains why the metals which exhibit passivity alone have very low overvoltages. In this case the reactions are

$$H + H \longrightarrow H^+ + H^- \longrightarrow H_2.$$

This is in accord with recent work by J. Heyrovský on the dropping mercury electrode, who shows that the passage from atomic to molecular hydrogen is better represented by the changes $2H \longrightarrow H^+ + H^- \longrightarrow H_2$ than by the change $2H \longrightarrow H_2$.

These views also carry those of H. S. Taylor, E. F. Armstrong and T. P. Hilditch on one hand, and those of I. Langmuir on the other, a definite step further. The former think that in a hydrogenation process at the surface of nickel, both reactants are attached to a single atom of nickel; the latter thinks that the reactants are adsorbed on adjacent atoms. In both cases the adsorption of the reactants is explained by the fact that nickel is not electrically neutral in the same sense as is zinc, and, in the first case, the subsequent reaction is explained by the mechanism given in (*d*) above, namely,

$$A_2 + B \longrightarrow A_2^+ + B^- \longrightarrow A_2B.$$

Since the passage from the passive to the active form involves the expulsion of an electron from an inner orbit, it is possible that when this change occurs in the presence of an adsorbed molecule, this molecule will be split into atoms, $A_2 \longrightarrow A + A$. This suggests an explanation for the well-known but unexplained observation that gases adsorbed on nickel, platinum, palladium, etc., are sometimes in the atomic condition. When a second molecule B comes sufficiently near to this atom and is capable of reacting with it, the reaction $A + B \longrightarrow AB$ occurs as I. Langmuir thinks.

A. S. RUSSELL.

Christ Church, Oxford,
December 8.

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### Weather Prediction from Observations of Cloudlets.

MAY I refer to the first letter of Sir G. Archdall Reid? (NATURE, November 7, p. 676). He says: "If then the behaviour of the smallest and thinnest fragment of cloud that can be clearly isolated be watched, it is usually possible to predict very quickly and with fair confidence the state of the weather for the next few hours. If the cloudlet waxes visibly, rain is almost certain; if it wanes, fine weather is equally probable; if it neither waxes nor wanes, existing conditions are likely to continue." It seems to me that the method of forecasting is falsified on every day on which clouds form and when rain does not follow, and there are very many such days in the year; for the cumulus of a fine day, which is common in spring, summer, and autumn, and occurs sometimes in winter, begins its life as a cloudlet, whether the ordinary man gets up early enough to see it or not. Certainly, too, cirro-cumulus often begins its life as cloudlets, but I have never seen cumuli "wane into cirro-cumuli" and rather doubt whether any one has ever observed such a phenomenon.

I do not think that Sir Archdall Reid quite appreciates my point about cirro-cumulus: we often see cloudlets of this variety waxing in one place and simultaneously waning in another; are we to predict rain from the waxing, or fine weather from the waning cloudlets, when both prognostics are occurring at one and the same time? Lenticular cirro-cumulus is composed of cloudlets that are born on the windward side and die in the leeward side of the cloud mass; in his first letter Sir Archdall Reid gives two possible explanations of this phenomenon; I should like to mention that it was these explanations to which I referred, and not any explanation of his main thesis, for as he says he gave none.

I quite agree that the waxing of cloudlets is often followed by rain, for we cannot have rain without cloud, but I think that it is just as often not followed by rain, and I certainly cannot think that if cloudlets wax visibly "rain is almost certain," for if this were the case we should have scarcely any rainless summer days. But Sir Archdall Reid seems less certain about the method in his second letter (December 12, p. 864) than he was in his first. I may be mistaken, but it seems to me that the method is scarcely of more use than the tossing of a coin; but, on the other hand, I am not sure that I understand the second of Sir Archdall Reid's definitions of cloudlets—"small and diaphanous clouds which can be seen at the same time in every part," and it is possible that our disagreement is based on our definitions of cloudlets. It would be interesting to know what those who are more familiar with forecasting than I am think of the question.

C. J. P. CAVE.

Stoner Hill, Petersfield,
December 22.

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THE correspondence on this subject in recent issues of NATURE has been of particular interest to me, because the observation of the waxing and waning of cloudlets has been made by me for the last four months in trying to forecast for the next few hours the probability of clear or cloudy weather. I may add that these observations have always been made about half-an-hour or so before sunset, for the following reason:

I have set myself the task of photographing the spectrum of a certain star on every fine night for a period of about 130 days, and I began this work on the night of September 9. The most convenient time for photographing this star is as soon after sunset as possible, when it is sufficiently dark.

As I have to go down 400 feet to get home, I prefer not to leave the observatory if the early evening is going to be fine.

On doubtful afternoons, therefore, I have studied the cloudlets, picking out the smallest and watching its behaviour. I have found that, in nearly every case, the waning cloudlet has given me for the next few hours clear weather. On the other hand, when the cloudlet increased in size I was nearly always doomed to a cloudy evening.

I have found, therefore, that this method is very successful at about the time of sunset, but have made no observations at other times of the day to test its value then. It has been most useful to me and saved me a great amount of unnecessary exertion.

WILLIAM J. S. LOCKYER.

Norman Lockyer Observatory,
Salcombe Hill, Sidmouth, Devon.

## On a New Porphyrin.

CHLOROCRUORIN is the name given in 1867 by Sir Ray Lankester to a pigment, red in concentrated solution, green dilute, dissolved in the blood plasma of Serpulid, Sabellid and Chlorhæmid polychæte worms. It has been shown (Fox, *Proc. Roy. Soc.*, in the press) that the chlorocruorin molecule is constructed on the same model as that of hæmoglobin. Oxy- and reduced chlorocruorin resemble oxy- and reduced hæmoglobin spectroscopically, with the corresponding bands moved to the red in the case of chlorocruorin. In a like manner, the derivatives of chlorocruorin which correspond to hæmochromogen, hæmatin and hæmatoporphyrin resemble these substances, with the same shift of the bands to the red.

There exists a family of pigments related to hæmoglobin. These are cytochrome, a complex of hæmochromogens present in most animal and many plant cells (Keilin, *Proc. Roy. Soc.*, B, vol. 98, 1925, p. 312); heliocorubin, a hæmochromogen in the gut of snails; and actiniohæmatin, in sea-anemones. Now, hæmoglobin, part of the cytochrome complex, heliocorubin, and actiniohæmatin all contain one and the same hæmatin nucleus (Anson and Mirsky, *Journ. Physiol.*, vol. 60, 1925, p. 161). Chlorocruorin, however, resembles hæmoglobin more closely in structure than do the other members of the hæmoglobin family which have just been referred to. Nevertheless, chlorocruorin does not contain the same hæmatin nucleus as these other pigments (Fox, *loc. cit.*). The reason for the difference existing between the hæmatin of hæmoglobin and that of chlorocruorin is that, whereas both contain iron, the former hæmatin has a different porphyrin from the latter.

This can be shown by treating both by Nencki's procedure for the preparation of hæmatoporphyrin.[1] Diluted Spirographis blood was extracted with acetic acid (1 part) plus ether (3 parts). The acetic acid was washed out with water, and the remaining ether solution of chlorocruorohæmatin was evaporated to dryness. The residue (with some sodium sulphite, to prevent oxidation of the porphyrin) was dissolved in hydrobromic-acetic acid. The porphyrin was driven by sodium acetate into ether and then taken back into hydrochloric acid (1 part HCl plus 2 parts water). Hæmatoporphyrin for comparison was prepared from hæmin with hydrobromic-acetic acid. The axes of the bands of the two porphyrins (both in HCl, 1 in 3) measured with Hartridge's reversion spectrometer (*Journ. Physiol.*, vol. 44, 1912, p. 1, and vol. 57, 1922, p. 47) were as follows:

| | | |
|---|---|---|
| Nencki's hæmatoporphyrin . . | 593 | 549 |
| Chlorocruoroporphyrin (Nencki's method) . . . . . . | 613 | 553 |

[1] I am indebted to Mr. R. Hill, of the Biochemical Laboratory, Cambridge, for valuable help.

H. Fischer and O. Schumm (*Zeit. Physiol. Ch.*, numerous publications in recent years) have added much to our knowledge of porphyrins. They show that porphyrins fall into two groups.

Group I. comprises porphyrins insoluble in chloroform. It contains (1) Coproporphyrin, extracted from human fæces and from yeast by ether-acetic acid, and (2) Uroporphyrin, found in pathological urine. Coproporphyrin is the porphyrin derived from a part of cytochrome (Keilin, *loc. cit.*). Cytochrome is present in relatively considerable amounts in yeast and in bacteria. Cytochrome (in yeast) gives in addition a porphyrin of Group II.

Group II. is formed by porphyrins soluble in chloroform and having the bands to the red of those of Group I. It contains (1) the porphyrin prepared from reduced hæmoglobin in whole blood by the action of HCl (Laidlaw, *Journ. Physiol.*, vol. 31, 1904, p. 467); (2) Kämmerer's porphyrin, extracted from putrefying blood by ether-acetic; (3) Papendieck's porphyrin, obtainable from fæces after a meat meal; and (4) Ooporphyrin, extracted by HCl from egg-shells.

The following table shows the wave-lengths of the band-axes of the principal of these prophyrins:

| Porphyrin. | Reference. | Axes of Bands in μμ. In Ether. | | | | In 25 per cent. HCl. | |
|---|---|---|---|---|---|---|---|
| GROUP I.: | | | | | | | |
| Coproporphyrin . . | Fischer and Schneller, *Z.P.C.*, vol. 130 | 624 | 571 | 528 | 499 | 594 | 553 |
| Ditto . . . . | Schumm, *Z.P.C.*, vol. 136 | 623 | 569 | 526 | 495 | 593 | 550 |
| GROUP II.: | | | | | | | |
| Laidlaw's porphyrin . | Schumm, *Z.P.C.*, vol. 132 | 631 | 575 | 535 | 502 | 602 | 557 |
| Kämmerer's porphyrin . | Fischer and Schneller, *Z.P.C.*, vol. 130 | 633 | 575 | 533 | 498 | 602 | 557 |
| Ooporphyrin . . . . | Fischer and Kögl, *Z.P.C.*, vol. 131 | 631 | 581 | 537 | 502 | 603 | 557 |

I next submitted chlorocruorin to a modification of Laidlaw's procedure for porphyrin preparation. Spirographis blood was treated with acetic-ether. The resulting chlorocruorohæmatin was taken into sodium carbonate solution and reduced with hydrosulphite. In a current of carbon dioxide, concentrated hydrochloric acid was then added. For comparison (1) the porphyrin from hæmin was prepared by a similar modification of Laidlaw's method, and (2) ooporphyrin was extracted from egg-shells with hydrochloric acid. The measurements of the bands with Hartridge's spectrometer are given below:

| | Axes of Bands in μμ. In Ether. | | | | In 1 part conc. HCl+2 parts Water. | |
|---|---|---|---|---|---|---|
| Porphyrin from hæmin | 632 | 585 | 536 | 503 | 600 | 555 |
| Ooporphyrin | 634 | 587 | 536 | 504 | 601 | 556 |
| Porphyrin from chlorocruorohæmatin | 641 | 580 | 553 | 512 | 614 | 559 |

It is seen that the bands of the porphyrin from chlorocruorin are situated considerably to the red of those of any of the above-mentioned porphyrins. This new porphyrin resembles the members of Group II. in being soluble in chloroform.

If the composition of the porphyrin of chlorocruorin is ascertained, valuable light may be thrown on the peculiar metabolic process by which a few annelids synthesise chlorocruorin while so many animals build up hæmoglobin.

H. MUNRO FOX.

Zoological Laboratory, Cambridge,
December 17.

### Blindness of Cave-Animals.

I DOUBT whether Sir Ray Lankester would maintain his theory of the origin of blindness in cave-animals, at least in the fishes living in the North American limestone caves, if he had carefully considered the observations on these fishes published by Eigenmann and other American zoologists. There are two points of special significance in relation to the question of selection by the escape from the caves of individuals with better developed eyes, versus direct influence of darkness on the eyes. The first is to what degree the actual ontogeny of the eye shows recapitulation, the second whether the individuals with power of vision would actually swim away from the darkness towards the light.

*Amblyopsis spelæus*, the most abundant of the blind fishes of the caves of central North America, reaches a maximum length of 13·5 cm. It is placed in a small family closely allied to the Cyprinodontidæ. This family includes five other species occurring in the same or contiguous regions. Three of these, *Chologaster agassizii*, *Typhlichthys subterraneus*, and *Troglichthys rosæ*, also live in subterranean streams in total darkness. Two of them, *Chologaster cornutus* and *C. papilliferus*, live exclusively in streams and swamps on the surface of the earth.

If we consider the eye of Amblyopsis as the example of the subterranean species which has been most thoroughly examined, the organ is visible as a minute black spot on each side in specimens 35 mm. long. Microscopically examined, it is very degenerate. The lens is very small and displaced, or entirely absent. The vitreous humour has disappeared, the remnants of the retina form an irregular mass in the cavity of the eye, the optic nerve can be recognised where it leaves the eye but cannot be traced to the brain. After the mature stage of the fish the eye undergoes further progressive degeneration.

With regard to recapitulation, the lens and optic vesicle develop in the embryo at the normal stage and in the normal manner, but soon begin to degenerate. The optic nerve also develops normally in the embryo. Defects due to mutation do not usually follow a normal initial development.

In *Chologaster agassizii*, which is also completely subterranean, the eye is normal in structure, and functional, but reduced in size. The fact that there are two other species of the same genus which live in daylight shows that this one cannot have been confined to darkness so long as the subterranean genera in which the eyes are degenerate and vestigial. If Sir Ray Lankester's theory were true, *C. agassizii* would not be in darkness at all but would have found its way out to the light. But it is probable that the instinct of all the species of Chologaster is not to seek the light but to avoid it. Eigenmann actually observed this in *C. papilliferus*, which is found under stones in the " springs " or small streams of south-western Illinois: the fish are negatively heliotropic, or photophobic. He found that this was equally true of Amblyopsis and Typhlichthys, which, notwithstanding their blindness, have retained the habit of hiding under stones and the ledges of rocks. In Chologaster there is evidence that the reduction of the eye has commenced in association with its photophobic habits without confinement to total darkness. In a specimen of Zygonectes, one of the Cyprinodontidæ, 38 mm. in total length, the eye was 2 mm. in diameter. In *Chologaster papilliferus*, 32 mm. in total length, the diameter of the eye was 0·83 mm. In *C. cornutus*, 32 mm. in total length, diameter of eye 0·96 mm. In *C. agassizii*, the subterranean species, 39 mm. in total length, diameter of eye 0·72 mm.

Lastly, it may be mentioned that in *Typhlogobius californiensis*, the eyes in the adult are minute and degenerate and almost if not quite insensitive to light. This fish lives in holes under stones, which it never quits. It can scarcely be maintained that it remains in dark holes because defects in vision make it unable to find its way out, especially as in the young state its eyes are visible and apparently functional.

J. T. CUNNINGHAM.

East London College,
December 12.

### Heterochromosomes and Polyploidy.

DURING recent cytological investigations in the Salicaceæ, undertaken to demonstrate the presence or absence of sex- or heterochromosomes in certain species of Salix, I have discovered such chromosomes in the males of *Salix lucida* Muhl., *S. aurita* L., *S. cinerea* L., and *S. Andersoniana* Sm. Of these species, *S. lucida*, an American form, belongs to the section Pentandræ of the supersection Pleiandræ, *S. aurita* and *S. cinerea* to the Capreæ group of the Diandræ, and *S. Andersoniana* to the Phylicifoliæ of the same supersection; all are, of course, diœcious. Of the polyploid series developed in Salix, *S. lucida*, *S. aurita* and *S. cinerea* are tetraploids, and *S. Andersoniana* hexaploid.

In the case of *S. lucida*, the heterochromosomes are easily discernible both in profile views of the heterotypical spindle in pollen mother cells and also in diakinetic figures. On the contrary, owing to the intimate relations between the paired chromosomes during diakinesis in *S. aurita*, *S. cinerea* and *S. Andersoniana*, they are not so readily recognisable at that stage in those species but stand out very clearly in heterotype metaphase side views.

In all four species, the larger member of the pair is more or less broadly (and occasionally obliquely) pear-shaped whilst the smaller is spherical; they lie on the periphery of the equatorial plate.

Although the mere demonstration of heterochromosomes in these species is in itself important, of even greater value is the light thrown on the development of polyploid series in plant genera. No matter what explanations are given of the origin of tetraploid species they all amount to the same in the end: whether we invoke chromosome division in the fertilised egg followed by a suspended mitosis, or any of the other theoretical explanations now current, in all there is implied a duplication of chromosome complement. Therefore, in diœcious plants possessing heterochromosomes, amongst the chromosomes so duplicated should be those chromosomes themselves, so that in the heterotype division of tetraploid species we ought to be able to detect two pairs of heterochromosomes and in hexaploids three pairs. However, careful examination has shown that in diploid, tetraploid and hexaploid alike only one pair is present. Hence, the problem of polyploid series in the Salices, and presumably in other genera, cannot have the simple solutions previously propounded, and the whole matter is thrown open for further consideration.

J. W. HESLOP HARRISON.

Armstrong College, Newcastle-upon-Tyne,
December 21.

# Coal Conservation and the Gas Industry.[1]

By Prof. J. W. COBB, C.B.E., The University, Leeds.

NOTHING has contributed more to the material advancement of civilised man from the state of his primitive ancestors than the utilisation of fuel for the production of light, heat, and power. Primitive man depended on the solar hear available from day to day, and his life was circumscribed accordingly. In temperate zones like our own, the sun's rays are too feeble and uncertain to enable us to obtain from them by direct means any considerable quantity of useful power, though in certain sunny regions, such as Egypt and California, it has been attempted. Even there, the amount and the cost of the plant for the production of the unit of power was excessive when compared with methods based on the use of fuel.

Vegetation, however, is capable of absorbing and storing up the radiant energy of the sun in the formation of organic compounds, which the plant is able to build up from carbon dioxide and water. In this way enormous quantities of fuel have been and are produced, by the combustion of which we are able to utilise indirectly the radiant energy of the sun absorbed by the plant in its synthetic processes. Man is, however, too impatient now to provide his fuel supplies by tree culture from one century to another, even were the necessary land available, while similar reasons rule out the cultivation of annual fuel crops in a crowded country such as Britain, where food crops must take precedence.

In default of fuel cultivation, we are compelled to rely on the accumulated store of fossilised vegetation in one or other of its existing forms. If we examine a table (below) showing the composition of dry, ashless

| | Carbon. | Hydrogen. | Oxygen and Nitrogen. |
|---|---|---|---|
| Cellulose ($C_6H_{10}O_5$) | 44·5 | 6·2 | 49·5 |
| Wood . . . | 50·0 | 6·0 | 44·0 |
| Peat substance . | 50-64 | 4·5-6·8 | 28-44 |
| Lignites . . | 60-70 | 5·0 | 20-35 |
| Bituminous coals . | 75-90 | 4·5-5·5 | 5·5-15·0 |
| Anthracites . . | 90-95 | 2-4 | 3 |

fuels, we see that the individual analyses show a gradual concentration of carbon at the expense of hydrogen and oxygen, so that we pass over from a substance such as dry wood or cellulose (a principal plant constituent) containing less than 50 per cent. of carbon to coals containing 80-90 per cent. and even more when anthracitic—a process which has been imitated in the laboratory, particularly in the experiments of Bergius. Accompanying this concentration of carbon is the production of a substance in which the heat energy is more concentrated, in fact a higher grade and more useful fuel. Thus 1 lb. of coal on completed combustion develops about double the amount of heat obtainable from 1 lb. of wood or cellulose, and this increases the difficulty of basing our fuel supplies on "fuel crops." The position is made worse by the fact that wood, even when air dried, contains 15-20 per cent. of moisture, and the heating value is correspondingly lessened.

In peat the concentration of carbon has begun, but the peat when freshly cut contains 80-90 per cent. of water—as much water as milk—and to make it useful as a fuel the moisture content has to be reduced to about 25 per cent. The bulkiness of peat, the problem of drying it, and its low heating value when dry, limit its value as a fuel greatly. A high nitrogen content is a point in its favour when conditions allow recovery of by-products.

Lignite is a more concentrated fuel than peat, but its moisture content may still reach 40-60 per cent. Its heating value remains low, but by drying, briquetting, and by carbonisation this fuel can often be turned to good account. It occurs usually at or near the surface and is won by mechanical excavation rather than underground mining. It is available, therefore, at the pit at a very low cost, and much of the German electric power supply is based on lignite. Abundant deposits occur and are being developed in Canada and Australia, but in Britain supplies are negligible.

The net result of this survey is to show that we in Great Britain are dependent almost exclusively on coal—a fossil fuel, a wasting asset—for the possibility of many manufacturing activities and amenities of life. The known deposits of coal in this country will suffice to meet the present rate of consumption for a long time, and improved mining technique has made available coal which a generation ago would have been thought unworkable. On the other hand, the cost of coal has increased, and coal forms a large part of the cost of producing some manufactured products such as iron and steel, on which in turn the engineering industry depends. As compared with other countries we shall, therefore, be at a disadvantage as soon as coal becomes difficult or expensive to get, even though we can get it at a price. Another consideration is the tendency to substitute mechanical appliances for hand labour, which tends to increase the consumption of coal, unless the efficiency of its utilisation can be correspondingly increased.

In considering the complete utilisation of coal, one must not overlook its potentialities as a source of chemical products. In the plant we have not only a cellulosic skeleton but also juices and spores containing resinous substances, and their degradation products form the two main types of components found in coal. It is the resinous bodies which cause many coals to fuse on heating and to evolve much gas, burning with a luminous smoky flame. It is owing to the absence of such components that anthracites burn smokelessly.

Coal when consumed in an ordinary grate goes through two stages. In the first is evolved the volatile matter, which if cooled and collected is found to consist of gas, a sticky oily liquid, tar, and a watery ammoniacal liquor. The porous solid residue, consisting mainly of "fixed" carbon with the ash of the coal, is known as coke.

The second stage of burning coal consists in the

[1] From a paper, entitled "The Conservation of the Nation's Store of Solar Energy," read at the Conference of the British Commercial Gas Association at Plymouth, October 21, 1925.

combination with oxygen of the air of both the volatile matter and the fixed carbon of the coke. In the domestic fire it is attempted to carry both processes on together. This has a certain advantage of simplicity but is unsatisfactory in other respects. Smoke cannot be avoided, especially when fresh coal is added to the fire, for the two stages of combustion can scarcely be kept in step, and incompletely burned tarry matter escapes up the chimney producing smoke. Such fires have a low efficiency. Only 20-25 per cent. of the heat of the coal is radiated into the room, while attendance to a fire involves labour and dirt.

The use of electricity instead, generated from the coal, has obvious attractions, but however efficiently it may be applied in the home, it must always be remembered that it carries on an average 10 per cent. and at best 20 per cent. only of the original heat of the coal. This 80-90 per cent. initial loss is too severe a handicap and entails an enormous waste of heat, though not apparent to the consumer. It seems to debar the use of electricity as a general domestic fuel.

An effective and logical remedy widely applicable consists in the initial carbonisation of the coal whereby the volatile matter is separated from the fixed carbon, as is done in the gas-works. In this way the coal can be resolved into a solid fuel—coke—a liquid fuel—tar (and motor spirit)—and a clean gas, all of which can be burned smokelessly and for most purposes more efficiently than coal. (The tar, though capable of serving as a fuel, has actually a greater value as a source of chemical products.) At the same time ammonia is recovered from the coal. This process of carbonisation, as carried out daily in the gas-works, does not waste the heat of the coal. The table below shows the fate of the heat units in the original coal after being subjected to carbonisation. The figures show the results of a year's working of a typical gas-works, not of the most modern type.

*Carbonising Gas Coal in Horizontal Retorts.*

| | |
|---|---|
| Heat of combustion of coal | 100·0 |
| Heat content : | |
| Gas | 22·5 |
| Coke sold | 48·3 |
| Tar | 6·0 |
| | 76·8 |
| Heat used and lost in manufacture | 23·2 |
| | 100·0 |

The heat units in the total coke made would be higher than the 48·3 per cent. shown, but some of the coke has been used for heating the retorts. Altogether, 23·2 per cent. of the heat of the coal has been used and lost in the process, leaving 76·8 per cent. in the products of carbonisation. This figure is termed the thermal efficiency of carbonisation. With more modern plant 80 per cent. would be a more representative figure. It is interesting to inquire what advantage is gained by carbonisation to compensate for the thermal and monetary cost of the process. From the watery product—ammoniacal liquor—is readily obtained ammonium sulphate, a valuable nitrogenous fertiliser. The tar is the raw material of a great industry. By suitable treatment it furnishes benzene and toluene, which were found so indispensable as the basis of manufacture of high explosives. From them and other tar constituents are derived numerous colouring matters, drugs, and disinfectants. The lighter tar fractions gain increasing importance as motor spirit, and the heavier constituents as a material for the construction of roads suited to the demands of modern traffic. Certain creosote oil fractions are valuable as preservatives of timber, or alternatively may be employed for the propulsion of ships. Coal-tar forms at present our most valuable source of home-produced liquid fuel, and its national importance needs no further emphasis. Clearly there is a considerable creation of value as a result of transforming the resinous constituents of coal into tar instead of allowing them to make smoke in the open grate.

Let us now consider the gas. Here reference must again be made to thermal efficiency, because it is so important in this connexion. The open fire is the most favoured method of heating rooms in our houses, and is, in my opinion, likely to remain so, whatever fuel may emerge in time as being the most satisfactory for burning in it. The peculiar value of radiant heat as thrown out from a fire has been appreciated by generations of our countrymen, and recent physiological work has shown that this peculiar excellence was by no means imaginary, but had a sound scientific foundation. But when we use raw coal in an open fire, we pay a big price—too big a price in many ways—for its cheery blaze.

The inefficiency of the coal fire is best seen when one compares it with the gas fire. For every 100 heat units supplied to a modern gas fire, practically half is radiated into the room, while with a coal fire the radiated heat is less than a quarter of that supplied in the coal. In both these cases there is, of course, a proportion of heat which goes up the chimney. With the coal fire it is inordinately large, but with the gas fire it is reasonable in amount, about one-third of the total. I say it is reasonable in amount because a certain quantity of heat going into the chimney does perform a useful function in ventilating a room ; and as the ventilating function of the open fire is probably as important as its heating function, a certain amount of heat may very well be devoted to this purpose. The trouble with the coal fire is that the proportion used in this way is much too large, wasting fuel, and over-ventilating the room to the extent of creating draughts. The gas fire is economical in the way in which it utilises the heat units brought by the gas for the combined purpose of heating and ventilating, which it does in an economical and practically convenient manner. It is sometimes said in extenuation of the very low thermal efficiency of electrical generation that the efficiency of an electrical heating appliance can be taken as 100 per cent. But plainly this can only be the case if no air goes into the chimney hot enough to produce the ventilation which is so essential, and in that case an auxiliary ventilating appliance must or should be provided, with additional cost.

This high efficiency of gas for room heating is typical of what it can do in many other uses, because it is so subject to simple and exact control that apparatus can be designed for burning gas of a much more refined and scientific construction than can be contemplated for the burning of coal. Moreover, not only is gas clean in the ordinary sense, but it also has been purified from nearly all its sulphur compounds at the gas-works, while it has to be remembered that every ton of raw coal which is burned in even the most modern steam-raising plant of a factory or electrical generating station turns out about half a hundredweight of sulphurous acids into the atmosphere. In this respect gas is superior not only to raw coal, but also to the smokeless solid fuels.

Nor is it to be forgotten in these days, when the electric motor has rightly come to occupy such a strong position for the provision of power, that the gas-engine is thermally more efficient than any other type of prime mover in common use, and that Sir Dugald Clerk has expressed the opinion only recently that, where a small isolated unit of power is required, a gas-engine using town gas is still the most economical plant available from both the thermal and the monetary points of view.

The solid smokeless fuel, or coke, resulting from carbonisation, is a subject to which the public attention has been very much directed lately by numerous utterances—æsthetic, hygienic, scientific, technical, and political—displaying very varying degrees of competence and impartiality. It may, however, be taken as agreed that for those domestic purposes where solid fuel continues for any reason to be used, it should be of the smokeless kind. There is no chance of our attaining the ideal of the smokeless city until that principle is applied.

The coke produced by the ordinary gas-works process is a form of solid smokeless fuel which is at the present time produced in large quantities. Other methods have been suggested and are being tried which have been grouped under the heading of low-temperature carbonisation.

Now it is to be remembered that in the earlier days of the gas industry, gas was made in iron retorts, which meant that of necessity lower temperatures were employed than are in common use to-day. The plain fact is that the development of the gas industry has proceeded in the direction of making more gas from the coal; and there is a sound reason for this, because every heat unit secured after the transformation of the carbonisation process in the form of gas is, from every point of view, thermal or monetary, worth so very much more than a heat unit in coal, and this appreciation in value is so much greater in the gas than it is in the tar or the coke.

The changes in gas practice have been in the direction of using higher temperatures, or even of gasifying some of the coke either in the gas retorts or in separate generators. The reversion to low-temperature carbonisation is not easy to justify. The carbonisation process has to be considered as a whole, as one yielding four main products—gas, tar, ammonia, and coke. Merely lowering the temperature gives very much less gas—say, about half. More tar is produced, not of a kind containing benzene or toluene, and more difficult to refine, but probably yielding more motor spirit. The ammonia yield is smaller. The coke is softer, easier of ignition than ordinary gas coke, and burns with more flame, but is more liable to crumble in manufacture and transport.

To counterbalance the loss of the high gas yield does appear to be an exceedingly difficult problem, as is now coming to be realised. I am far from saying that it is insoluble, but it would appear to necessitate either obtaining a very high order of value in the by-products, or of evolving some process of carbonisation very much less costly than has hitherto been used; and neither of these is the easy thing to do which optimistic utterances would suggest.

The production of smokeless solid fuel, however, is not necessarily bound up with low-temperature carbonisation. Low temperature is only one of the factors involved. The transmission of heat through coal during coking, the physical and chemical changes which occur, and the extent to which the carbonisation process can be speeded up and modified by proper preparation of the coal, all require exploration. The gas industry is becoming increasingly alive to the possibilities in this direction, to the necessity for thorough and systematic examination of all the factors operating in the carbonisation process, and an investigation of what can be done, for example, by proper preparation of the coal, which may involve washing, grinding, blending, and briquetting, or even the addition of some inorganic constituent, because, strange though it may seem, the presence of some of the ash constituents, such as oxide of iron, has been shown to exercise a marked influence on the coking process and the nature of the coke produced. The further control of the quality of coke and its supply in a form which is not crumbly, but easily ignited, burning cheerfully and not leaving too much ash, is one of the most interesting things with which the gas industry is now occupied.

I may, however, at this point indicate that undoubtedly the best utilisation of smokeless solid fuel will also be greatly helped by a more careful study of the best construction of grate for burning it, since the grate as at present used has been evolved for the burning of raw coal, the requirements of which are somewhat different. There is little doubt that, if the house grate of to-day was slightly, but suitably, modified in construction, quite a hard coke would burn well in it. As regards the efficiency obtainable from coke, all the tests made by Dr. Margaret Fishenden, on behalf of the Fuel Research Board, indicate that it is appreciably higher than that obtainable from raw coal (which is all to the good), though nothing like so high as that obtainable from a gas fire.

Enough has now been said to indicate clearly that, apart from other considerations such as those of cleanliness and hygiene, the gas industry is entitled to put forward the claim that, on the basis of thermal efficiency alone, its methods of dealing with our coal supplies represent the highest order of actual achievement in the present. What it may be able to do in the future it is not possible for any one of us to foresee. Its problems become more interesting every day, necessarily more complicated, and make more demands upon those engaged in it. But the position of the gas industry is scientifically sound; and by systematic and patient research and trained intelligence applying the results of research to technical and commercial developments, that position can be made even more assured.

## Cosmic Rays.

By C. S. WRIGHT.

THE recent address by Prof. Millikan, printed in NATURE of December 5, together with the popular statements in the daily press, have directed attention once more to certain geophysical problems which have received scant attention lately from British investigators. Details of Millikan's observations on the top of Mount Whitney are still lacking, but it seems clear that another phase in the investigation may now be regarded as terminated.

The first phase of the investigation opened with the discovery in 1901, independently by C. T. R. Wilson and Geitel, that within a closed vessel there was a continuous production of gaseous ions which rendered the contained gas conducting to a minute extent. This observation was followed by the discovery, by Elster and Geitel, of the existence of radioactive products in the atmosphere which might be responsible for some part at least of the conductivity observed. Observations of the radioactivity of the air or, more correctly, measurements of the ionisation due to the active products collected on a negatively charged wire, led to the certainty that the products were due to the disintegration of radioactive emanations derived from the soil, springs, etc. A systematic investigation of the various types of rock by the present Lord Rayleigh soon yielded representative figures for their radium content, but it was not until 1908 that an accurate value for the mean radium content of the air near the ground (about $10^{-16}$ gm. per c.c.) was available as the result of the work of Eve, Satterly, and Ashman. These efforts made it clear that the radioactivity of earth, air, and—to a minute extent—water, must all be regarded as possible contributors to the ionisation in closed vessels.

In the meantime another plan of attack was developed in Canada in 1902 by Rutherford and Cooke, and McLennan and Burton, followed by Wright and others. This attack was directed towards localising the source of the penetrating radiation and determining its hardness or penetrability. Screens of lead were used by the first-named investigators, while McLennan and Burton, having found that the local water supply was free from radioactive impurity, surrounded their vessel with layers of water up to 60 cm. thick. Both experiments were successful in reducing the ionisation by about 30 per cent. Rutherford and Cooke increased the amount of lead in their screens to a total weight of 5 tons, but no greater decrease was observed than with a screen thickness of 3 cm. It was also found that the radiation in the basement of the laboratory in Montreal apparently came equally from all directions. In the attempt to reduce the ionisation further, and in the hope of localising its sources, Wright was driven in 1908 to undertake field observations over the surface of Lake Ontario, on frozen lakes, and in a deep tunnel at Niagara Falls. These experiments showed a notable reduction over the water and ice, but no reduction in the tunnel, and enabled an estimate to be made for the contribution of the earth to the measured ionisation. Though later work has thoroughly confirmed the efficacy of the water and ice-screens, an observation on the University tower at Toronto conflicted with observations by von Bergwitz, McLennan and Macallum, and Wulf, all of whom found a decreased ionisation at a height above the earth. This discrepancy may have been due to a local concentration of radioactive material at the place of observation.

In the interval a further line of attack had been opened by the discovery of a daily variation in the penetrating radiation by Campbell and Wood (1907), Strong, and Wulf, though these observations were flatly contradicted by those of Gockel, Wright, and Cline. This contradiction was later recognised as due to local variations in the relative importance of the different sources of ionisation. It was indeed not until 1909 that the relative importance of these various sources was realised with any certainty, and particularly the part played by that source which was chiefly responsible for the local daily variation in the penetrating radiation. This source was a surface deposit of radioactive materials derived from the air and resulting from radioactive emanations coming from the soil. These active materials are continually being deposited on the earth's surface at a rate dependent both on the varying value of the earth's potential field and upon the amount of active material in the atmosphere, while the normal rates of decay of the radioactive substances while in the air and on the ground set a limit to their accumulation.

This phase of the investigation may be regarded as closing with the determination in 1910 by Simpson and Wright, during the course of Capt. Scott's last Antarctic expedition, of the contribution to the ionisation by the radioactive surface deposit on the ship after immersion in land-derived breezes of measured radioactivity. The slow rate of decay of the ionisation, after the return to normal sea conditions of low-air activity, indicated the presence of thorium as well as radium products on the ship's structure. The absence of a daily variation during the voyage was clearly due to the continuous low activity of the ocean breezes.

These data, and those obtained by many others on land, showed that the chief recognised sources of penetrating radiation were the active surface deposit, radioactive substances in the earth, and active products derived from emanations which might enter the ionisation vessel if steps were not taken to exclude them. The effect of radioactive materials in sea-water, or ice, beneath, and in the atmosphere round and above, the place of observation were recognised as inappreciable. Even under the most favourable conditions, however, there remained still an ionisation about half as great as the minimum land value, and the source of this residual ionisation was still unknown at this date. Possibly the view that the residual effect was due to a slight radioactivity of all materials was the most popular one. One of the earliest investigations had, in fact, arisen from the discovery of lead as the end-product of the radium transformations, which led McLennan and others to the observation that the substance of the ionisation chamber, *e.g.* lead, may contribute notably to the conductivity. Though some samples of lead were clearly radioactive, no definite conclusion was reached on the question whether all substances were radioactive in some degree, or whether the differences with different metals were due to a secondary radiation from the walls of the container.

The second phase of the investigation may be said to commence with the initiation of measurements in balloons by Gockel and later by Hess, who established the fact that, during an ascent, there was first a decrease, and later an increase, in the measured ionisation. To explain this increase, Hess assumed the existence of a "sehr durchdringende Strahlung ausserterrestrischen Ursprungs," which was responsible even for a portion of the ionisation at sea-level. A similar increase with height was observed in balloon ascents over the sea. This work was continued by Kohlhörster during 1913 and 1914, with improved apparatus, the balloons ascending in one case to a height of 9 km., and an attempt was made to calculate the absorption coefficient of the radiation from the relation between height and ionisation. These results indicated, on the assumption that the radiation was directed vertically downward, that the hardness of these rays was about six times as great as the hardest known $\gamma$-rays. Radiation of this hardness would be able to penetrate through the atmosphere to sea-level in measurable amount. These results were confirmed by numerous German observations made on mountain tops. Kohlhörster,[1] in his 1923 paper, calculated the absorption coefficient of the cosmic rays from the later balloon observations and from screening experiments in water and in glacier ice. The absorption coefficients so obtained showed considerable consistency, and the average value was given as $\mu$ (water) $= 2 \cdot 5 \times 10^{-3}$, *i.e.* the rays were found to be more penetrating even than the first upper-air observations showed. This absorption coefficient compares with $\mu$ (water) $= 3 \cdot 9 \times 10^{-2}$ and $3 \cdot 3 \times 10^{-2}$ for the hard $\gamma$-rays of radium C and thorium D.

In the same paper, Kohlhörster discusses the source of the cosmic rays in the light of a variation observed by him during the day in a glacier crevasse, and even under 4·5 metres of glacier ice. He tentatively ascribed the variations to the changing orientation of the crevasse with respect to sources in the neighbourhood of the Milky Way. In fact, the tentative conclusion was in favour of an origin such as the red giant stars or nebulæ.

In the absence of detailed results, the observations of Millikan seem to confirm and also to extend those of Kohlhörster, though there is one point at least on which there is some disagreement. In addition to giving a new figure for the absorption coefficient—$\mu$ (water) $= 1 \cdot 8 \times 10^{-3}$—corresponding to a greater hardness even than was thought, Millikan adds that the rays extend throughout a spectral region from 0·0004 Å.U. to 0·00067 Å.U., and that the secondary rays from the cosmic radiation show the Compton effect. From the wording of Prof. Millikan's address it seems that he has measured the difference in wave-length between the primary and secondary scattered rays. He states that the cosmic rays come into the earth with equal intensity at all hours of the day and with practically the same intensity in all directions. It is this conclusion which appears to be in disagreement with Kohlhörster's results, though it is true that the daily variation observed by the latter was not pronounced.

[1] *Sitzungsber. d. Preuss. Akad. der Wiss.*, 34, 1923.

The minimum wave-length of the cosmic radiation quoted by Millikan is only $\frac{1}{50}$ that of the hardest known $\gamma$-rays of radioactive type, the wave-length being in fact of the order of the distance over which the positive charge of the atomic nucleus behaves as if it were a point charge. It is therefore difficult, as Millikan points out, to escape the conclusion that the rays arise from transformations actually in the nuclei of atoms. As to the origin of the cosmic rays, it is difficult to consider the possibility of their initiation except in certain portions of space where the existence of atoms stripped of all their electrons may be suspected, and where absorption of the rays near the source will not be excessive. Some such considerations doubtless led Nernst to the view that the origin of the very penetrating radiation might lie in the nebulæ of low density.

The scattered radiation will, by virtue of the Compton effect noted by Millikan, bridge the gap between the cosmic rays and the gamma-rays from radioactive substances, but unless a method of producing these rays in the laboratory can be developed, the only possibility of experimenting effectively with them will be by observations at high altitudes. Lest it should be thought that these rays might fulfil the function of the "ultra-X" rays which Perrin has postulated as the possible cause of radioactive transformations, it is well to point out that early measurements of the ionisation in closed vessels in tunnels and in deep caves gave values which were sometimes as large as those made on the earth's surface above. As these results could only have been due to radioactivity of the rock forming the cave, it is clear that Perrin's postulate is not in any way rendered more probable by the existence of rays of the hardness noted.

While we may consider Millikan's fine achievement as terminating the second phase of the investigation, it seems certain that there are other developments to follow. It is possible that there is still some ionisation in closed vessels which is not accounted for, and for which a separate cause must be found. The lowest values obtained in a metal vessel over the sea correspond to the production of about 4 pairs of ions per c.c. per sec. Of this number, between one and two pairs seem to be due, directly and indirectly, to the cosmic rays. According to Kohlhörster the ionisation is greater by the production of 4, 9, and 17 pairs of ions at heights of 3, 4, and 5 km. above sea-level. A contribution of about 2 pairs may result from the surface deposit of radioactive materials on a small ship such as the *Terra Nova*, this being derived originally from land sources. An addition of 6 pairs or more is to be expected in land observations, in part due to radioactivity of the soil and in part to additional radioactive deposits on neighbouring surfaces. The effect of this deposit is equivalent to about 0·5 gm. of radium per sq. mile, on the average. The amount of this land contribution will of course vary with the site of the measurements, and one is probably not far wrong in estimating that, on the average, the land effect is due about equally to the two sources stated. An exceptionally low value of 2·6 pairs of ions was obtained by McLennan and Murray over Lake Ontario, using an ionisation chamber of ice, while observations in an ice cave on the shores of the Antarctic Continent gave a minimum value of 3 pairs, though too much reliance must not be placed on this figure. It is, however, known that the air radioactivity in this place is only slightly greater than over the ocean. Any residual ionisation which has not been accounted for is therefore minute in amount. The final results of Prof. Millikan's observations may settle this point, but the very slightest trace of radioactive impurity in or on the walls of the vessel would cause an ionisation sufficient easily to account for any difference. Measurements in a metal chamber under varying high pressures is one investigation which would probably give useful information on the residual effect, if made in a submerged submarine in order to exclude the cosmic rays.

Though the ionisation currents dealt with in work on penetrating radiation are small — of the order $10^{-14}$ to $10^{-15}$ ampere—the measurements can be made with considerable accuracy, so that there is no possibility for doubt as to the reality of the existence of the cosmic rays. It is, however, a matter for regret that laboratory experiments on the properties of these rays cannot be carried out effectively in Great Britain, since it is only at great altitudes that the cosmic rays contribute more than a fraction of the total ionisation. The possibility of the discovery of a laboratory source of these rays must be regarded as remote, though it is unwise to be dogmatic even on this point.

## Mineral Production in India.[1]

AMONG the many useful services rendered by the Geological Survey of India must be reckoned the issue of a Quinquennial Review of the Mineral Production, initiated during the directorship of Sir Thomas Holland. The first of these reviews appeared in 1905 (*Rec. Geol. Surv. India*, Vol. 32, Part I.), and covered the period 1898–1903. Since then, four others have been published, the latest, covering the period 1919–23, being a voluminous and interesting account of the progress during the period, contributed by the director (E. H. Pascoe) and the senior officers of the Survey, including L. L. Fermor, J. Coggin Brown, H. C. Jones, C. S. Fox, and W. A. K. Christie.

The average annual value of the output in India of minerals for which trustworthy returns of production are available, during the five years 1919–23 inclusive, was as follows :

| | *l.* |
|---|---|
| Coal | 9,252,649 |
| Petroleum | 7,036,298 |
| Gold | 2,094,323 |
| Manganese ore | 1,995,341 |
| Salt | 948,245 |
| Lead and lead ore | 881,710 |
| Silver | 642,450 |
| Mica | 633,331 |
| Saltpetre | 355,118 |
| Tin and tin ore | 214,500 |
| Tungsten ore | 135,845 |
| Iron ore | 114,956 |
| Jadestone | 114,329 |
| Ruby, sapphire and spinel | 60,660 |
| Chromite | 53,764 |
| Monazite | 29,294 |
| Copper ore | 29,053 |
| Magnesite | 16,334 |
| Diamonds | 7,262 |
| Graphite | 265 |
| Total value | 24,615,727 |

Of the countries in the British Empire, India stands second as regards coal output, being well ahead of the Union of South Africa, Canada, and Australia, although the output of rather more than twenty-one million tons in 1924 amounted to less than 8 per cent. of the output of Great Britain. Of the Indian output, more than 98 per cent. was from Gondwana coalfields, including 52 per cent. from the Jharia field and 28 from the Raniganj. The Bokaro field, with 4·7 per cent. of the output, is now ahead of the output of the Giridih and Singareni fields. It is expected that the Bokaro will before many years prove to be one of the great coalfields of India. Coal exports during the period ranged from a maximum of 1¼ million tons in 1920 to a minimum of 77,000 tons in 1922. In its coal export trade to ports in the Indian Ocean, India has to compete with Japan and South Africa, both of which countries are regarded as formidable rivals in this trade. The employment of by-product ovens in coke-making has of late been considerably extended, as also has the employment of electrical energy in mines for pumping, etc.

The large increase in annual value of the petroleum output from an average of 1,073,604*l.* during the period 1914–18, to an average of 7,036,298*l.* for the period under review, does not indicate a corresponding increase in the actual output, which averaged 282,594,121 gallons annually during the former period as compared with 299,453,675 during the latter period. The large increase in value referred to is attributed chiefly to the fact that the value of petroleum during the former period was much under-estimated, and partly to the high exchange value of the Indian currency in 1919 and 1920, during which years there was an increased output. The director of the Geological Survey thinks the chances are that the next five years will show a smaller increase of output than was shown by the last five years, and possibly even a decrease. India still contributes only a very small part of the world's supply of petroleum, the output for 1923 being only 0·83 per cent. of the world's marketed production.

The period was one of substantial progress for the iron and steel industry in India, which was in a declining condition at the outset of the quinquennium. In spite of this progress, however, a Tariff Board was appointed recently to inquire into the question of protection for the steel-making industry. As a result of its inquiry the Tariff Board concluded that, without some form of protection, the Indian steel industry would certainly not develop for many years, and might even cease to exist. Following the Board's recommendations, the Legislative Assembly quite recently (September 1925) agreed to a grant of a maximum of

[1] *Records of the Geological Survey of India.* Vol. 57: Quinquennial Review of the Mineral Production of India for the Years 1919 to 1923. By the Director and Senior Officers of the Geological Survey of India. Pp. viii+398+lxxi+5 plates. (Calcutta : Government of India Central Publication Branch, 1925.) 5.10 rupees ; 9*s.* 3*d.*

60 lakhs of rupees to the steel industry up to March 1927, after which date, when the Protection Act expires, the question will be reconsidered.

India assumed leadership in the production of manganese ore so early as 1907, and, after a relapse in the years 1912–15, regained it during the War period, in spite of much competition from Brazil. The report states, however, that discoveries of new and valuable deposits of manganese ore seem to have ceased, and that the period under review has been marked by stability in this section of the mining industry, accompanied by gradual development of some deposits and exhaustion of others. The average annual output of manganese ore for the period was 624,635 tons, compared with 577,457 tons in 1914–18, and 712,797 tons in 1909–13.

The output of chromite (chromium ore), which had increased substantially during the War period, continued to increase during the period under review, the average annual output being 35,000 tons as compared with an average of 23,000 tons for the previous quinquennium. The increase was due chiefly to greater activity in the chrome mines of Baluchistan.

The output of tungsten ore in Burma, which had increased greatly during the War period, having reached 4542 tons in 1917, dwindled during the period under review to an output of 872 tons in 1923. The tin output, on the contrary, showed an increase to an average annual of 138 tons (metal) compared with an average of 116 tons for the preceding quinquennium.

The gold-mining industry of India suffered during the War period, during which the average production was a little less than 587,000 ounces annually. The decline in output has continued steadily through the period under review, during which the average was 459,875 ounces.

Further marked progress is reported in the output of the lead-silver-zinc mines at Bawdwin and Namtu in Burma. The output of lead extracted from the ore at these mines rose steadily from 19,000 tons in 1919 to 46,000 in 1923, while that of silver increased from more than two million ounces in 1919 to about five million ounces in 1923.

India is the leading producer of mica of good quality. We learn, moreover, from this report that the art of producing fine splittings of mica by hand is practised more efficiently in India than in other countries, so much so that during recent years India has imported mica for conversion into fine splittings for export. India also holds a monopoly in shellac production, which gives her power to control the production of micanite if necessary.

The average annual output of magnesite, chiefly from the deposits at Salem in Madras, increased by 77 per cent. in the period under review.

There was no progress in the jadeite industry during the period dealt with. The average annual exports amounted to 4628 cwt. as compared with 4651 cwt. during the previous quinquennium, but the value was much higher.

The output of monazite declined substantially during the period 1919–23, having fallen from 2000 tons in 1919 to only 125 tons in 1922.

The output of bauxite during the period continued low, averaging 5220 tons annually. The returns for 1924, however, show an increase to 23,228 tons of bauxite, from 6547 tons in 1923. By far the larger part of the 1924 production was from the Kaira district, in the Bombay Presidency.

Among new and interesting features in the mineral production of India, mention may be made of ilmenite, zircon, sillimanite, and kyanite. Ilmenite and zircon occur with monazite in the beach sands of Travancore, and are obtained as by-products in the magnetic concentration of the monazite. The outputs of ilmenite for 1922, 1923, and 1924 were 400, 700, and 641 tons respectively, while those of zircon were 160, 145, and 365 tons respectively.

Sillimanite has in recent years come into prominence as a refractory, and much interest has been taken in the deposit of the Khasi Hills, Assam, which was formerly thought to be one of corundum. Four outcrops of sillimanite have been found, but the extent of the deposit is not known. The quantity of boulders, etc., at the surface is stated to amount to about 3000 tons. No sillimanite appears in the production statistics of 1923 and 1924.

A discovery of kyanite was made in the Lopso Hill area, Kharsawan State, Singhbhum, in 1921. Analyses show the rock to consist of practically pure aluminium silicate, and experiments show that it is suitable for use as a refractory. Several hundred tons have been sent to England, and it is thought that a demand for it as a refractory may arise. An output of 224 tons of kyanite is reported in the production statistics of the Geological Survey for 1924. T. C.

## Obituary.

### MR. J. H. MAIDEN, I.S.O., F.R.S.

ON November 16, at his residence, Turramurra, Sydney, the death occurred of Joseph Henry Maiden, who in 1924 retired from the position of Director of the Sydney Botanic Gardens and Officer-in-Charge of the Centennial Park. Mr. Maiden was born at St. John's Wood, London, on April 25, 1859, and received his early education at the City of London Middle Class School. He soon showed a taste for science, and for some time was assistant to the late Prof. F. Barff. He came to Australia in 1880, for health reasons, having provided himself with a return ticket, but the climate proved so beneficial that he decided to remain, and became associated with the formation of the Technological Museum, Sydney, of which he was Curator from 1881 until 1896, and he soon began to study the native plants. Some of his early botanical lessons were learnt from the late Rev. Dr. William Woolls, of whom he always retained the most affectionate memories. He was also a colleague in botanical work of the late Baron von Mueller in his latter days, another of the great pioneers of Australian botany. Mr. Maiden was Superintendent of Technical Education from 1894 until 1896; Consulting Botanist to the Departments of Agriculture and Forests from 1890; Director of the Botanic Gardens, Sydney; and Government Botanist from 1896 until his retirement in 1924.

The particular genus which Mr. Maiden studied most intensively was that almost exclusively Australian one —Eucalyptus—and he added very many new species to the list previously known, his field of investigation extending all over Australia. By his enthusiasm and energy he formed the present Herbarium at the Sydney Botanic Gardens, one of the finest in the southern hemisphere, and made many personal journeys in the various States for material to enrich his collections. He also, at considerable trouble, obtained type specimens which were collected in Australia in the early days, but had been housed in herbaria in other parts of the world, including some collected by Sir Joseph Banks in 1770.

Perhaps Mr. Maiden's greatest work in the field of botanical research is his "Critical Revision of the Genus Eucalyptus," of which sixty-four parts have already appeared and others are going through the press. Another valuable publication is the "Forest Flora of New South Wales," of which seventy-seven parts have been issued. Other publications included "Illustrated Flowering Plants and Ferns of New South Wales" and "Useful Native Plants of Australia." He made numerous contributions on various subjects to the *Agricultural Gazette of New South Wales*, and the service he has rendered in the interest of forestry in this State has been very great.

Mr. Maiden was honorary secretary of the Royal Society of New South Wales for twenty-two years, and president in 1896 and 1911; president of the New South Wales Horticultural Society for twenty years and of the Horticultural Association for eighteen years, as well as president of the Linnean Society of New South Wales and the Royal Australian Historical Society, in each case for two years. He was a man full of energy, and one of the most outstanding features of his activities was his industry. He never seemed to tire of writing up and placing on record any scientific facts which made for the advancement of knowledge, his contribution to the Royal Society of New South Wales being forty-five papers, the last having been presented in 1925, while his papers to the Linnean Society of New South Wales amounted to ninety-five. He entertained a very high regard for Sir Joseph Banks, whom he styled "The Father of Australia," and his biography of Sir Joseph, written chiefly for the purpose of raising funds for a memorial to that great botanist, is considered to be a classic. Mr. Maiden was one of the chief originators of the National Wattle Day Celebration in the Commonwealth, which has for its object the cultivation of an Australian national sentiment, while keeping in view that this country forms part of the British Empire.

In 1915 Mr. Maiden was awarded the Linnean Medal by the Linnean Society of London, this being the first occasion upon which this medal had been won by an Australian. He was elected a fellow of the Linnean Society in 1888, and in 1916 was honoured by having the Imperial Service Order conferred upon him, and also by being elected a fellow of the Royal Society. In 1921 he was offered the presidency of the Australasian Association for the Advancement of Science, but declined it for health reasons, and in 1922 was awarded the Mueller Medal by that body, of which he was honorary secretary for fourteen years; in 1924 he gained the Clarke Memorial Medal awarded by the Royal Society of New South Wales.

Mr. Maiden ranks among the half-dozen leading pioneering botanists who have contributed so much to our knowledge of the unique Australian flora, and for many years was regarded as the doyen of Australian botanists. He served as an inspiration to very many science students, probably more than ever will be known, and as some evidence of the affection and esteem in which he was held by his colleagues in science he was, in 1916, presented with his portrait in oils. In addition to the amount of scientific work which he carried out as the result of his own investigations, he was an outstanding benefactor to scientific progress generally, and being a born organiser added great strength to those societies which were reached by his influence. Truly it may be said of him that he left the world richer for his labours, and his life was filled with greatness, nobility and sincerity.

R. H. CAMBAGE.

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WE regret to learn from the *Chemiker-Zeitung* of the death of Dr. Erich Krause, director of the laboratories of the Wood Carbonisation Co. of Constance. Krause was born at Weissenfels and educated at Leipzig and Vienna. At Vienna he became assistant to Prof. Skraup, in conjunction with whom much of his original work was published. The researches were partly in organic chemistry and partly in physical chemistry and were concerned mainly with the investigation of proteins. In 1911 he entered the service of the Holzverkohlungs-Industrie, when he devoted his energies to the perfection of analytical methods, his main results being published in the new edition of the well-known work of J. König, "Die Untersuchung landwirtschaftlich und gewerblich wichtiger Stoffe." In collaboration with his colleagues he worked out a process for obtaining methyl alcohol from natural gas. During the War, Krause devoted much time and attention to the problem of finding food-substitutes.

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WE regret to announce the following deaths:

Dame Louisa Aldrich-Blake, D.B.E., Dean of the London (Royal Free Hospital) School of Medicine for Women, one of the first among medical women to practise general surgery, on December 28, aged sixty years.

Prof. Matthew Curry, formerly professor of engineering at King's College, London, on December 29, aged seventy-four years.

Dr. C. Gessard, of the Institut Pasteur, Paris, who isolated a pyocyanic bacillus from pus in 1882, and was also known for his work on oxydases and on bacteria generally.

Dr. J. G. M'Kendrick, F.R.S., emeritus professor of physiology in the University of Glasgow, on January 2, aged eighty-four years.

Prof. Alfred Perot, professor of physics in the École Polytechnique, Paris, and president of the Commission de Métrologie, on November 27, aged sixty-two years.

Sir R. Douglas Powell, Bart., K.C.V.O., physician in ordinary to the King, president of the Royal College of Physicians in 1905-10, and formerly president of the Royal Medical and Chirurgical, the Clinical and Medical Societies, on December 15, aged eighty-three years.

## News and Views.

THE list of New Year honours includes the following names of men of science and others associated with scientific work:—*Privy Councillor*: Lord Bledisloe, Parliamentary Secretary to the Ministry of Agriculture and Fisheries. *Baronets*: Mr. W. W. Butler, member of Council, University of Birmingham, and Sir Robert Jones, president of the Association of Surgeons of Great Britain. *Knight Commander of the Order of St. Michael and St. George (K.C.M.G.)*: Prof. M. W. MacCallum, vice-chancellor of the University of Sydney. *Knights*: Prof. T. Hudson Beare, Regius professor of engineering, University of Edinburgh; Dr. R. A. Bolam, chairman of council, British Medical Association; Prof. J. B. Farmer, professor of botany, Imperial College of Science, South Kensington; Major A. McN. Cooper-Key, chief inspector of explosives, Home Office; and Mr. P. J. Hartog, vice-chancellor of the University of Dacca. *Companion of the Order of the Bath (C.B.) (Civil Division)*: Mr. Arthur H. Smith, late Keeper of Greek and Roman Antiquities, British Museum. *Companion of the Order of the Indian Empire (C.I.E.)*: Lieut.-Col. J. W. D. Megaw, director of the School of Tropical Medicine and Hygiene, Calcutta.

THE New South Wales Government has announced its decision to close the State Observatory, which for many years has been under the control of Prof. W. E. Cooke. Owing to the growth of Sydney, the site of the Observatory has become quite unsatisfactory and its work has suffered in consequence. The necessity for removal to a distant suburb has repeatedly been urged upon successive State Governments; but the Labour Ministry's method of dealing with the problem has come as a distinct surprise. It is unlikely that this abrupt decision will mean withdrawal of governmental support of astronomical work in New South Wales, and it may serve a very useful purpose in focussing attention upon, and possibly leading to a settlement of, the question as to whether the individual States, or the Commonwealth, should take charge of such work. Some years ago the Commonwealth accepted sole responsibility for meteorological services, and the consequent co-ordination of effort has had highly satisfactory results. The establishment of the Commonwealth Solar Observatory at Mount Stromlo, Canberra, has already provided a precedent for the entry of the major Government into astronomical work, and there are many people who strongly favour its assumption of control over all the Observatories. The New South Wales decision will not take effect immediately, and in the meantime the whole situation, as it affects all the States, will be given most careful attention. Possibly this apparently hostile act on the part of a State government may prove, in the end, to be a blessing to astronomy in Australia.

IT is only a year or two ago since G. F. and G. M. Dick in the United States described an intracutaneous immunity test for scarlet fever. They used a soluble toxin elaborated by a blood-destroying streptococcus microbe which was isolated from cases of scarlet fever, and they developed a new theory of this eruptive fever, namely, that it was really a localised disease of the throat caused by a specific streptococcus producing a toxin which, on absorption into the blood stream, gave rise to constitutional symptoms associated with a characteristic rash. Already the "Dick test" has been applied to enormous numbers of people especially in the United States, and it is now coming into prominence in the English medical Press. The *Lancet* of Dec. 26 contains three papers on the subject by Drs. Joe, of Edinburgh, Silcock, of Leicester, and O'Brien and Okell, of the Wellcome Research Laboratories. The paper of the last workers, entitled "Some Problems connected with the Dick Test," is particularly interesting, dealing as it does with the difficulties of the test and the real significance of negative and positive reactions as measures of the immunity in scarlet fever. It is known, broadly, that a negative response indicates a high degree of non-susceptibility to the disease, but Drs. O'Brien and Okell are not equally certain that a "positive" and particularly a "partial positive" reaction may not indicate some immunity. They also tentatively touch the question whether there may not be immunologically distinct types of the disease as occur in other well-known bacterial infections. Already there are some indications that the so-called streptococcus of scarlet fever may not be so specifically distinct as was believed a year back.

THE rapid progress that is being made by telephony is proved by the statistics published in *Electrical Communication* last October by the International Standard Electric Corporation of New York. The problem of giving telephone service becomes more complicated every day. Every new subscriber makes the problem more difficult. In 1905 there were 300,000 telephone sets in operation in the New York metropolitan area. There are now 1,900,000, and it is estimated that by 1945 there will be at least four millions. The number of telephone stations at present is 130, 26 having been added during the last year. Some of these are enormous buildings serving 100,000 subscribers, and very costly to erect. The introduction of automatic switching adds considerably to the complexity of the problem. In the United States and Canada the number of telephones for each hundred inhabitants in 1924 was 13·7 and 11 respectively. In Europe, Denmark heads the list with 8·7, Sweden comes next with 6·7, and Norway third with 6·1. Germany has 3·8, Great Britain and North Ireland 2·5, and France 1·5. Curiously Great Britain, Germany, and Switzerland have almost exactly the same number of miles of telephone wire per inhabitant. The number of telegrams per inhabitant in all countries is only a small fraction of the number of telephone conversations. In the United States, Denmark, and Sweden the fraction was less than one-hundredth in 1923, and in Great Britain and France it was less than one-twentieth. Long-distance telephony is making very satisfactory progress in the United States. The Chicago-New York cable which was started in 1918 is practically completed. One of the most serious difficulties that had to be overcome was the effect produced by the changes of temperature occurring every twenty-four hours. This produced a thousand-fold difference in the amount of electrical energy received over the line from the same input. Automatic regulators are employed which vary the amplification introduced by the thermionic valve repeaters with the temperature of the cable conductors.

LIEUT.-COL. THE HON. CUTHBERT JAMES, president of the College of Pestology (Incorporated), sends us a long letter upon the steps which led to the conversion of the Incorporated Vermin Repression Society into the College, and the character and work of this institution, by way of comment upon the note which appeared in NATURE of December 12, p. 875, referring to a public appeal for twenty thousand pounds to establish a memorial to the late Prof. Maxwell Lefroy. We pointed out that the college had no connexion with the University of London and suggested that any memorial would be more appropriately associated with the Imperial College of Science, where Prof. Lefroy was professor of entomology, than with such a propagandist organisation as that of which Lieut.-Col. James is president. We do not doubt that, as he remarks, " so far as it lies in the power of the College to make it so, its affairs are arranged strictly according to Cocker," but the fact that the authorities of the Imperial College refused to take part in the meeting called by the College of Pestology to arrange for the proposed memorial is in itself sufficient to show their attitude towards the originators of the appeal and their intentions. Lieut.-Col. James informs us that his appeal committee would welcome the addition of Prof. Lefroy's scientific colleagues as members, and we are glad to make his invitation known to them and any others who may wish to support a movement to obtain by public subscription the sum of twenty thousand pounds for " a chair and centre of applied biology at the College of Pestology, Bedford Square."

A DISCUSSION was opened at the Institute of Actuaries at the end of October by Mr. F. A. A. Menzler with the hope of indicating extensions of the work of the actuarial profession. He suggested that the application of statistical methods in business may afford a useful opening for any one who has been trained to examine statistics scientifically. Unfortunately, he discounted his advocacy by saying that there is no need to know about correlation and by implying that, while the mathematics of correlation are frightening, the subject of sampling is easy. Modern work on small samples demands as much hard thinking on mathematical lines as correlation, and it seems strange that any one should approach the matter in Mr. Menzler's way before a body which has not only published a text-book dealing partly with correlation, but also examines to some extent on the subject. Apart, however, from the lack of accuracy in some of the views expressed about modern statistical methods, there is a strong case to be made for the use of all scientific machinery in practical work, and an inefficient or out-of-date instrument is as unwise in statistics as in anything else, as is indicated in the leading article of this issue. Nobody would employ any one but a trained chemist to do chemical analysis, but many concerns will hand over statistical analysis to any one who may be on the staff instead of employing someone really qualified to do the work. Our leading article (p. 37) indicates some aspects of the subject which merit the earnest consideration of scientific workers and business men.

AT the December meeting of the American Geographical Society, the following awards were announced:—The David Livingstone Centenary Medal for 1925 to Luis Riso Patrón, Director of the Oficina de Límites of Chile, for " scientific achievement in the field of geography of the southern hemisphere," in recognition of his contributions to Chilean cartography; Señor Patrón headed the first Chilean Commission to make a precise survey of the Cordillera of the Andes, and as director of the Oficina de Mensura de Tierras he was responsible for the great map of Chile on a scale of 1 : 500,000; the David Livingstone Centenary Medal for 1926 to Erich von Drygalski, of the University of Munich, for his work in the South Polar regions; Dr. von Drygalski carried out notable glaciological and other investigations in the Arctic as leader of the Greenland Expedition of the Berlin Geographical Society (1891–1893) and of the German Antarctic Expedition of 1900–1903. A Charles P. Daly Medal for 1925 to Brigadier-General David L. Brainard, in recognition of his achievements on the Lady Franklin Bay Expedition under Greely in 1881–1884; a Charles P. Daly Medal for 1925 to Captain Robert A. Bartlett, for his services to Arctic exploration; as commander of the *Roosevelt* (1905–1909) he took a leading part in Peary's expedition to the Pole; on the Canadian Arctic Expedition of 1913–1918 he commanded the *Karluk*, and in 1917, under his able seamanship, the Third Crocker Land Relief Expedition achieved success. A Cullum Geographical Medal for 1925 to Pedro C. Sanchez, Director of the Central Mexican Bureau of Geography and Climatology, in recognition of his contributions to Mexican cartography; he has been in charge of the geodetic service of Mexico since 1912; a Cullum Geographical Medal for 1925 to Harvey C. Hayes, research physicist of the United States Navy, for his invention of the sonic depth finder; a Cullum Geographical Medal for 1925 to Lucien Gallois, of the University of Paris, for his work in the advancement of geography; by notable contributions to the history of geography, and by his interpretation of the spirit of geographical science, he has extended his influence far beyond the bounds of France.

LECTURING on " Primitive Transport " at the Edinburgh and Lothians Branch of the Royal Anthropological Institute on December 15, Mr. K. G. Fenelon said that transport methods were developed in early times and among primitive peoples, and unusual modes of locomotion are frequently to be explained by the circumstances of the time or by the nature of the materials available. Thus the passenger- and goods-carrying wheel-barrow of the Chinese has its *raison d'être* in the narrow causeway raised in the middle of bad roads; canoes in the Arctic are naturally constructed of animal products, while in other parts vegetable materials are more usually employed. The beginnings of commercial intercourse between nations or peoples were generally by land. Primitive peoples living on islands, as those in the Pacific, may develop a considerable technique of canoe-building for purposes of war or trading. In such areas, however, the natural conditions have concentrated transport development along that line of progress to the exclusion of others. Man is undoubtedly the most primitive means of transport. The next stage of development is marked by the introduction of the pack animal. The earliest forms of vehicle would appear to be the slide-car or sledge. Though the origin of the cart is lost in antiquity, there seems to be little to object to in the usual theoretical explanation that it arose from the slide-car, the stages in transition being the use of log rollers, solid drum wheels, built-up drum wheels and the spoked wheel. The simplest types of canoes are improvised from solid tree-trunks. The next stage is the dug-out canoe, planks being often added to give a greater height above water level. Bark, wicker and skins are also utilised. The outrigger canoe may have been evolved from rafts raised on floats. The sail is widely distributed, though curiously enough it seems to have been little known among the natives of North and South America.

THE *Kew Bulletin* announces that Mr. C. C. Calder, Curator of the Herbarium of the Royal Botanic Garden, Calcutta, has been appointed Director of the Botanical Survey of India and Superintendent of the Royal Botanic Garden, Calcutta, and of Cinchona Cultivation in Bengal.

PROF. F. P. SLATER, formerly head of the Physical Laboratory in the Experimental Department of the Fine Cotton Spinners and Doublers Association, Ltd., and lately professor of textiles in the University of Manchester, has been appointed chief of the Experimental Department of the Association in succession to Dr. W. Laurence Balls.

THE Ministry of Agriculture and Fisheries has re-imposed, starting on January 1, the admission fee of one penny—on other than students' days—to the Royal Botanic Gardens, Kew, which was abolished in April 1924, and previously yielded a revenue of about 5000*l*. per annum. The present admission fee of 6d. on students' days (Tuesdays and Fridays) will continue to be charged.

DR. G. CLARIDGE DRUCE was elected a corresponding member of the Société Botanique de Genève at the recent jubilee celebrations. Dr. Druce has just completed his account of the botany of Huntingdonshire in the "Victoria History of the Counties of England," which treats of about 800 species; he has already completed accounts of the botany of the counties of Berks, Bucks, Oxford and Northampton for this work.

A CONFERENCE on "The Growing of Lucerne" will be held at the Rothamsted Experimental Station on Wednesday, January 27, at 11.30 A.M. The chair will be taken by the Right Hon. Lord Clinton, and the speakers will include Sir E. J. Russell, Prof. R. G. Stapledon, Mr. J. Mackintosh, Mr. A. Cunningham and Mr. H. G. Thornton. Those intending to be present should notify the Secretary, Rothamsted Experimental Station, Harpenden.

THE French Government has conferred upon Sir Robert Hadfield, Bart., the Cross of an Officer of the Legion of Honour, in recognition of his noteworthy contributions to our knowledge of metallurgy. Sir Robert was elected a corresponding member of the Paris Academy of Sciences in 1923, and recently presented a paper to the Congress of Industrial Chemistry organised in Paris by the French Society of Chemical Industry, in which he showed the great debt which metallurgy owes to French scientific workers.

THE Dyers' Research Medal for 1924–25, offered by the Society of Dyers and Colourists, has been awarded to Dr. F. M. Rowe for the paper entitled "The Identification of Insoluble Azo Colours on the Fibre and of Azo Pigments in Substance," which was published in the July 1924 issue of the Society's journal, and a Certificate awarded to the co-author, Miss Clara Levin. The Medal is offered each year by the Company for the best scientific research or technical investigation connected with the art of dyeing submitted to the Society for publication in its journal.

PROF. DAYTON C. MILLER, professor of physics in the Case School of Applied Science, Cleveland, Ohio, has been awarded the American Association Prize of 1000 dollars for his paper on "The Michelson-Morley Ether-Drift Experiment, its History and Significance," delivered at the recent Kansas City meeting of the Association. The Prize, which was founded by a member of the Association shortly before the Cincinnati meeting in 1923, is given annually for "some noteworthy contribution to scientific advancement presented at the meeting" of the Association.

THE Carnegie Trust of the United Kingdom has generously come to the assistance of the Geographical Association with a gift of 1000*l*. towards equipping the Library of the Association, especially in the matter of sets of foreign periodicals. The Carnegie Trust is specially interested in assisting isolated students and has organised the Central Library for Students, Galen Place, W.C.1, with this in view. The Library of the Geographical Association will henceforth be affiliated to that Library, and the Association hopes that its usefulness to teachers and students all over Great Britain may be thereby increased.

A MODERATELY strong earthquake was felt about 12.30 P.M. on December 23 in the island of Mull and the district around Oban. The shock lasted about five seconds and was accompanied by the usual rumbling noise. The earthquake seems to have originated in or near the same centre as the Oban earthquakes of November 28, 1880, and January 17, 1907, which disturbed areas of about 50,000 and 3100 square miles respectively, the former being felt over nearly all Scotland and in the north-eastern counties of Ireland. If the tremor observed at Bothwell at about 12.35 P.M. and in Glasgow should prove to be connected with it, the shock was probably rather stronger than that of 1907. So far as known, no damage was caused by the earthquake.

THE sixth International Ornithological Congress will be held at Copenhagen on May 24-29 under the presidency of Dr. E. Hartert, of the Zoological Museum, Tring. The work of the Congress will be divided into five sections dealing respectively with: (1) Systematic ornithology, geographical distribution, palæontology; (2) anatomy, physiology, heredity and evolution; (3) biology, including ecology and bird migration; (4) oology, nidification; (5) bird protection and aviculture. The executive committee of the Congress includes representatives of Denmark, France, Germany, Great Britain, Sweden and the United States; the British members are Messrs. W. Sclater and H. F. Witherby. Communications for the Congress should reach the honorary secretary, Mr. P. Bovien, c/o Mr. E. Lehn Schiöler, Uraniavej, 14-16, Copenhagen, Denmark, not later than May 16.

ACCORDING to the Rome correspondent of the *Times*, the Italian cabinet has approved a bill creating an Italian Academy, the objects of which will be the "co-ordination and direction of Italian intellectual movements in the field of science, letters, and arts, the preservation in these activities of the national character according to the traditions of the race, and the encouragement of its expansion and influence abroad." The Academy will receive an annual subsidy from the State, and grants and pensions will be assigned to authors, artists, and scientific workers, inventions examined and schemes for intellectual advance instituted. Membership will be limited to sixty, the first thirty being nominated by Royal decree, on the advice of the President of the Council, and the remainder during the next ten years from a list of names preferred by the existing Academicians. Academicians will have the privileges of high State officials and will wear a special uniform.

WE learn that the beam stations for short wave radio communication which Marconi's Wireless Telegraphy Co., Ltd., is erecting for the British Government and for the Governments of the Dominions and India, are making satisfactory progress. It had been hoped that the Canadian and South African stations would be ready for working by the end of 1925, but their completion has been delayed by the illness of Senatore Marconi and Mr. Franklin. It is expected, however, that the beam services between Great Britain and Canada and South Africa will be ready for working in April next, and that the services with India and Australia will be in operation about the middle of August. A beam station is being erected at Dorchester for communication with the United States and with South America. A corresponding station is being built in Brazil for the account of the consortium of the four wireless companies operating in South America. The Company is also constructing stations connecting Portugal and her Colonies and linking up Portugal with the rest of the world. This programme of construction involves the expenditure of approximately 1,000,000*l.* sterling.

IN referring to the report of the British Photographic Research Association (December 26, 1925, p. 944), we perhaps did not make it sufficiently clear that while the members of the staff of the Association took a very active part in the matter of the standardisation of plate-testing methods, the proposals that were placed before the sixth International Congress of Photography were drawn up by a committee appointed by the Scientific and Technical Group of the Royal Photographic Society.

WE have received the annual report and statement of accounts of Livingstone College for 1924–25. The College does a valuable work in imparting to those entering the mission field the elements of a medical training. Owing to a decrease in fees and extraordinary expenditure on making up roads adjoining the College there is a deficit on the year's working of 1340*l.* Subscriptions are appealed for, either for general purposes or to provide a memorial to the late Dr. Harford, the founder and first principal.

IN the notice of the Ray Society volume, "The British Hydracarina," by C. D. Soar and W. Williamson, in NATURE of December 26, 1925, p. 932, the bibliographic details might be taken to imply that this book was published by the British Museum (Natural History). We are asked to point out that this is not the case, and that the Ray Society has no official connexion with the British Museum apart from the fact that permission has been given for the Museum to be used as the official address of the Secretary of the Society. Messrs. Dulau and Co., Ltd., 34-36 Margaret Street, London, W.1, are the agents for the sale of the Society's publications to non-members and to the trade.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A professor of mycology at the Imperial College of Tropical Agriculture, Trinidad—A. Aspinall, Imperial College of Tropical Agriculture, 14 Trinity Square, E.C.3 (before end of January). A head of the Electrical Engineering department (*not engineering* as advertised in NATURE of January 2) of the L.C.C. Hackney Institute—Education Officer (T. (1) (a)), County Hall, Westminster Bridge, S.E.1 (January 18). A borough analyst and Corporation chemist for the County Borough of Salford—Medical Officer of Health, 143 Regent Road, Salford (January 20). A demonstrator in inorganic and physical chemistry at King's College, London—The Secretary (January 20). A Secretary to the Queen's University, Belfast—The Vice-Chancellor (January 30). A senior lecturer (male) in zoology in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the

Union of South Africa, Trafalgar Square, W.C.2 (February 15). A dairy bacteriologist at the Harper Adams Agricultural College, Newport, Salop—The Principal. A junior professional assistant in the Meteorological Office—The Secretary (S.2), Air Ministry, Adastral House, W.C.2. A research assistant in the physiology department of the Middlesex Hospital Medical School—The School Secretary, Middlesex Hospital Medical School, London, W.1. A temporary lecturer in mathematics at the University College of Swansea—The Registrar, University College of Swansea, Singleton Park, Swansea.

## Our Astronomical Column.

COMET ENSOR.—A little more information has come to hand about this comet, which raises hopes that it may be an object of considerable interest next February and March. A telegram from the Cape Observatory was circulated by the I.A.U. Bureau on Dec. 18; it gave the position on Dec. 14 at $18^h\ 30^m$ U.T. as R.A. $3^h\ 38^m$, S. Decl. 61° 12′; daily motion minus 12 minutes of time, south 24′. A further telegram from S. Africa appeared in the *Times* of Dec. 19, stating that an orbit had been deduced which indicated Feb. 12 as the date of perihelion, and some thirty million miles as the perihelion distance. These facts, with the above position and motion, have enabled Dr. A. C. D. Crommelin to deduce the following rough orbit:

$$T = 1926,\ \text{Feb. } 12{\cdot}5\ \text{(assumed)}.$$
$$\omega = 5°\ 16'$$
$$\Omega = 284\ \ 17$$
$$i = 123\ \ 13$$
$$\log q = 9{\cdot}4072$$

An ephemeris from this orbit shows that the comet may be expected to be visible in England about Feb. 16, when it will be a morning star 1° east of the sun, and 4° north of it; it may then be visible in the twilight and have a considerable tail (it had one 15′ long at discovery). It continues its northward course, and by March 4 will be 35° north of the sun; it will rise $4\frac{1}{2}$ hours before sunrise, and will thus be visible on a dark sky; it will afterwards become circumpolar, but will fade rapidly. This forecast should only be taken as giving a general idea of the course of the comet, the data being rough. But it may be expected to be the brightest comet since Mellish's of 1917.

The following elements have been telegraphed to the I.A.U. Bureau, Copenhagen; they were computed by Mr. H. E. Wood, of the Union Observatory, Johannesburg, from observations made there on Dec. 14 to 16 (about):

$$T = 1926,\ \text{Feb. } 12{\cdot}41\ \text{U.T.}$$
$$\omega = 353°\ 44'$$
$$\Omega = 282\ \ 17$$
$$i = 122\ \ 52$$
$$\log q = 9{\cdot}5250$$

EPHEMERIS FOR $0^h$.

| | R.A. | Decl. | log *r*. | log Δ. |
|---|---|---|---|---|
| Jan. 31 | $21^h\ 31^m\ 39^s$ | 30° 40′ S. | 9·6476 | 0·1139 |
| Feb. 16 | 21 2 8 | 13 31 S. | 9·5384 | 0·0892 |
| Mar. 4 | 20 59 24 | 18 10 N. | 9·8028 | 9·9777 |
| ,, 20 | 21 58 56 | 55 4 N. | 9·9846 | 9·9620 |
| Apr. 5 | 1 58 43 | 76 19 N. | 0·1049 | 0·0696 |

NAKED-EYE SUNSPOTS.—On the few days during the past three weeks when observations of the sun were possible, a number of sunspots were visible. Two of these were so large that they were obvious naked-eye objects. The first of the two groups, consisting of a pair of large spots, was south of the sun's equator, and crossed the central meridian on Christmas day. The other group, made up largely of one great spot, was in north latitude 23° and was on the meridian three days later. It is the largest group of spots seen as yet this cycle, and is comparable with the largest groups of the preceding cycle, such as the great spot of August 1917 or the long stream of March 1920.

Of the three large spots noted in these columns in the issue of December 9, the third group (Nov. 18-30, latitude 17° N.) lasted long enough to cross the disc again. The leader spot of the stream was alone represented, however, but though the train had died out, its position was marked by an extensive region of bright faculæ clearly seen near the east and west limbs of the sun.

The following table continues the information of naked-eye sunspots given in two previous numbers:

| Date on Disc (1925–26). | Central Meridian Passage. | Latitude. | Maximum Area. |
|---|---|---|---|
| Dec. 19–31 | Dec. 25·4 | 20° S. | 1/550 |
| Dec. 22–Jan. 3 | Dec. 28·3 | 23° N. | 1/400 |

(Areas express the proportion covered of the sun's hemisphere.)

On December 27 and 28, two moderate magnetic disturbances were registered at Greenwich, the time corresponding roughly to that of the transit of the large northern spot. The movements shown by the magnets were, however, much inferior to those of a "magnetic storm." There have been no other recent magnetic disturbances of any consequence.

The year 1925 has shown a pronounced increase in the number and size of sunspots, especially during the latter half of the year; but the average latitude (about 20°) in which the spots have appeared indicates, from their corresponding latitude and frequency in previous cycles, that their maximum occurrence will be nearly two years hence.

THE DECEMBER METEORS.—Mr. W. F. Denning writes: "This shower was unusually strong this year on several nights, especially on December 12 and 13, and the time of greatest abundance appears to have been observed on December 12 at about $20^h$ new G.M.T. Mr. R. M. Dole of Lansing, Michigan (Lat. $43\frac{1}{2}$° N., Long. 85° W.), says: 'The Geminids were magnificent this year. The rate on December 10 was 30-40 per hour from a point about 2° W. of Castor. On December 12 the radiant was between α and β Geminorum 1/5 the distance from α to β.' He watched the shower between $7^h\ 45^m$ P.M. on the latter night and $2^h\ 3^m$ A.M. (local time) December 13. The horary rate at about 10 P.M. was 60, and this went on increasing so that at 2 A.M. the rate was more than 240 per hour. They were short, swift, red; very few left trails. A great number were about 6-7 magnitude. At about 1.50 A.M. several bright ones were seen, mostly dark red. It is possible that the maximum may have been after 2 A.M. The display seems to have been nearly equal to that witnessed on December 13, 1920, in the early morning, by two ladies at Bournemouth, when at the lowest estimate 5 per minute were counted, or 150 in half an hour's record, though the sky was partially cloudy.

"The meteors were also seen at their recent return by Mr. A. King, in Lincolnshire, who obtained a very successful series of observations on the nights December 10-14. He did not witness the same abundance as that reported from the United States, but conditions were not so favourable. On the early evening of December 13, meteors were casually observed to be surprisingly numerous by Mr. J. Johnson and some friends from the Devonshire moors.

"The writer pointed out the probability of a rich return of these meteors on December 12, $20^h$ (new G.M.T.), in *Monthly Notices, Roy. Ast. Soc.*, vol. 84, p. 178. Mr. Dole's observation has proved that it occurred at the time and in the strength expected."

## Research Items.

A Portrait-Statue from the Congo.—In *Man* for December, Mr. T. A. Joyce figures and describes an example of the royal portrait-statues of the Bushongo. Four of these statues were brought back from the Congo by Mr. Torday in 1909, of which three are now in the British Museum and one in the Musée du Congo Belge, Tervueren. This present example, the fifth known, which has recently been acquired by the Musée du Congo Belge, represents Mikope Mbula, 110th paramount chief of the Bushongo. Native report states that these statues of chiefs were carved only when an artist of sufficient calibre was discovered. The statue of Mikope Mbula conforms to the traditional pattern. It is of hard reddish wood and is some 62·8 cm. in height. The chief sits in the conventional cross-legged pose, his left hand holding a knife, his right on his knee. His ornaments and dress—a belt ornamented with cowries and a belt supporting a sitting cloth and armlets—are indicated by carving. An engraved brass ring is around his neck. The five statues are evidently the work of three different artists, of whom the sculptor of the present figure is inferior in expression of character, although in two points at least he is more correct—the proportion of the lower limbs and the details of the hands. The distinguishing emblem of this chief is a human figure sculptured on the plinth in front of him which may represent his slave-wife and refer to the fact that in his reign, marriage with a slave—previously forbidden—became a legalised practice.

Sumeria and India.—In the October issue of the *Journal of the Royal Asiatic Society*, Mr. Mackay returns to the question of early relations between Mesopotamia and India which was raised by Sir John Marshall's description and illustrations of seals and other objects from the Indus Valley in the *London Illustrated News* of September 27, 1924. The seal, showing a figure of a bull standing over a heap of grain and three signs, one of them a fish, was found in 1923, in a chamber nearly two metres below the surface on the north-east side of the ziggurat of the Temple of Ilbaba at Kish, but is undoubtedly of earlier (Sumerian) date. Its resemblance to the seal found at Harappa is unquestionable. Further evidence of contact is seen in a number of beads, necklaces of carnelian and lapis lazuli, found in the last two seasons in graves at Kish, which are provisionally dated at 3000 B.C. The lapis lazuli might have come from Persia, but in view of the fact that India from time immemorial has been the home of carnelian working, the beads were submitted to Sir John Marshall, and pronounced by him to be similar to beads found in great quantities in India, dating from early to recent times. The technique of the Kish beads seems to be identical with that of the Indian beads. Every consideration points to India having been their place of origin or else a country with trade relations with both India and Mesopotamia. The lapis lazuli beads do not show the same finish in workmanship, and were therefore probably made by a different people.

Sea Trout.—An addition to the steadily accumulated mass of valuable data, due to the work of the scientific staff of the Fishery Board for Scotland, with regard to the salmon and sea trout is given us by Mr. G. H. Nall in a " Report on a Collection of Sea Trout Scales from the River Hope and Loch Hope in Sutherland " (Fishery Board for Scotland, Salmon Fish., 1925, No. 1, Edinburgh and London, H.M.S.O., 3*s*. net). The material examined was collected during January and March, and July and August. Whilst the bulk of the scales were of normal type, there were some on which a period of rapid growth in winter was followed by a winter zone and a weak summer growth in the following year; on others there was little differentiation between river and sea life. Erosion was well marked in autumn and winter on the scales of maturing fish and kelts, but, in some cases, the erosion which was slight and regular round the periphery of the scales suggests the possibility of spawning marks being undetected occasionally. The greatest number of smolts, 60 per cent., migrated to the sea after three years' river life, 10 per cent. after two years, 26 per cent. after four years, and 4 per cent. after five years. For the Forth, Menzies found 68 per cent. migrating after two years, 31 per cent. after three years, and an odd fish going down after four years. As is pointed out by Mr. Nall, this illustrates the rule that the farther north a district lies the longer is the parr life. The data show a tendency for the younger smolts to mature later than do the older smolts. The period between the smolt migration and the first spawning varies from one to four years; the greatest numbers spawn in the second winter after migration as smolts, and those which do not spawn until the third winter are more numerous than those which spawn as finnock; after first maturity, the majority of the fish become annual spawners. Information respecting three out of seven recaptured marked trout was sent without an accompanying sample of scales. This is unfortunate and suggests the desirability of giving more publicity to the experiments. It is also desirable that some records of temperature be made during winter feeding to check the statement that abundance of food, not high temperature, is the dominant factor in producing wide rings on the scales of the Salmonidæ.

Enzyme in Plant Gums.—Oxidase and diastase activity have been found in plant gums by Gilbert J. Fowler and M. A. Malankdar (*Journal of the Imperial Institute of Science*, Bangalore, Vol. 8 A, Part 12), these enzyme activities being much more marked in two gum-oleo-resins, myrrh gum and the gum of *Boswellia serrata*, than in gum-arabic. In the case of the Boswellia and myrrh gums, there is evidence that the oxidase may consist of the usual peroxidase-oxygenase system, and an alcohol soluble catechol compound may form part of this system. Analyses for manganese do not suggest that the traces of this element present can be correlated with the oxidase activity. The diastatic enzymes saccharify starch solutions, but are without action on unchanged starch or gum and have no dissolving action on hemi-celluloses. There is a note of some interesting experiments suggesting enzymic conversion of tannins into non-tannins by extracts of these gums.

The Andaman Sea Basin.—Major R. B. Seymour Sewell has commenced a systematic study of the Indian Seas, and in a first paper (*Mem. Asiatic Soc. Bengal*, vol. 9, No. 1, 1925) he deals with the geotectonics of the Andaman Sea. The Andaman-Nicobar ridge connects the Arakan Yoma with the main ranges of Sumatra. It probably began to rise from the sea-floor in early Tertiary times as part of the outer arc of the great Alpine-Himalayan system. Simultaneously a shallow-water basin formed on the east, into which poured the great alluvium-charged rivers of Burma, and from which the waters escaped into the Bay of Bengal through channels between the Islands. At a much later date the Straits of Malacca were formed and permitted the entry of the Pacific shallow-water fauna into the Andaman Sea, where already an Indian Ocean fauna was flourishing. The same sequence of structural elements—upfolds, depressions and volcanic belt—can be traced across Burma, from the Bay of Bengal to the Mergui Archipelago, and from the Indian Ocean across Sumatra to the Malayan ridge. The greater part of the Andaman Sea is a large basin, but on the west it is complicated by the volcanic belt of Barran Island and Narkondam. Farther south, olivine-basalt has been dredged from a depth of 1240 fathoms, 35 miles east of the Central Nicobars. The distribution of coral-rock throws new light on the recent development of the Andaman anticline. Raised coral-beaches along the eastern coasts of the Islands indicate uplift, while a barrier reef, much interrupted, occurs on the west and points to subsidence on that side. Many other topics of geological and oceanographic interest are discussed; and all the available data of a fascinating and little known region are brought to bear on the problem of its origin and evolution.

CRETACEOUS GASTROPODA FROM PORTUGUESE EAST AFRICA.—Mr. L. R. Cox has described a series of Gastropoda from Catuane and Incomanini in Portuguese East Africa (*Ann. Transvaal Mus.*, 11, Pt. 3). The deposits at the former locality are considered to be Upper Albian, while those of the latter probably belong to the Upper Mæstrichtian. The Catuane fauna is represented by nine species, three being described as new, while in point of numbers an indeterminate Chenopus is the most abundant form present. Of the sixteen species in the Incomanini fauna, not one has been identified with any previously known form, but they appear to indicate shallow-water and possibly estuarine conditions at the time of the deposition of the beds. The two plates on which these fossils are represented are very unsatisfactory.

NEW MAGNETIC ALLOYS.—In the September issue of the *Journal de Physique*, M. H. Tscherning gives the results of his comparison of the magnetic properties of the new alloys "permax," manufactured by the Imphy Steel Works, and "permalloy," manufactured by the Western Electric Co. Both specimens were in strip form and were coiled spirally to make rings on which were wound the magnetising and induction coils. The induction coils were connected to a Grassot fluxmeter, the readings of which were taken for each change of current in the magnetising circuit. For a maximum field of 1 gauss, permax has an induction of 3350 gauss, a residual of 2760 gauss, and a coercive force of 0·45 gauss. Under the same conditions, for permalloy the figures are 7500, 4900, and 0·075 respectively. With the maximum field raised to 200 gauss, permax has an induction of 10,800 gauss, residual about 5000 gauss, and a coercive force only 0·48 gauss, while for permalloy and for electrolytic iron the figures are of the order of 19,000, 10,000, and 1 respectively. Permax is therefore inferior to permalloy in permeability but has a smaller hysteresis loss in strong fields and seems less liable to change its magnetic properties under rough treatment.

THE NUCLEUS OF RADIOACTIVE ATOMS.—In a paper in the *Comptes rendus Acad. Sci.*, Paris, of November 20, M. J. Thibaud assumes that a radioactive nucleus consists of a very dense central portion with a total positive charge $Ne$, that the force around it is central and given by the formula

$$F = Ne^2(1 - b^{a-2}/r^{a-2})/r^2,$$

and that certain positive elements of the nucleus move as satellites round this central portion in the narrow region where the force upon them is attractive. It can be shown that the only periodic orbits possible are circles and that the motions in them are unstable, which would account for the disintegration of these atoms. It is assumed that these orbits are quantised, like Bohr's electron orbits in the external portion of the atom. The $\gamma$-rays emitted by these elements apparently obey quantum laws, and the author finds in the case of mesothorium 2, by assuming $a = 3$, $N = 100$, $b = 3{\cdot}29 \times 10^{-12}$ cm. and that the emitting particle is a proton, that the energy differences $W_n - W_1$ as observed and as calculated are almost identical, $n$ the quantum number having the different values 2, 3, 4 . . . 8. $N$ and $b$ agree with values obtained for the charge and diameter of a heavy nucleus by studying the deviations of colliding $\alpha$-particles. The agreement is not so good when $a$ is assumed to be 4 with a revolving $\alpha$-particle.

THE AMMONIUM RADICAL.—Direct experimental evidence for the tetrahedral distribution of the hydrogen atoms of the ammonium radical about the nitrogen atom in simple ammonium compounds is given by W. H. Mills and E. H. Warren in the *Journal of the Chemical Society* for November. Spiro-ammonium salts were investigated and, by a simple diagram, it is shown that resolution is possible if the ion has the tetrahedral configuration. Fractional crystallisation of the bromocamphorsulphonates yielded *d*-spiroammonium bromide, molecular rotation $[M]_{5461}$ of $+50{\cdot}5°$ and the corresponding *l*-salt $[M]_{5461}$ of $-50{\cdot}8°$.

PHOTOCHEMICAL DECOMPOSITION OF SILVER CHLORIDE.—The microbalance has been employed by E. J. Hartung to investigate the photochemical decomposition of silver chloride. The work is described in the *Journal of the Chemical Society* of November; thin films of chloride on silica sheets were sealed in tubes with different chlorine absorbents. After insolation for definite periods, the tubes were opened, air, nitrogen, or hydrogen admitted, and the films weighed. The decomposition into silver and chlorine has a maximum value of 91·1 per cent., 89·8 per cent., and 94·8 per cent., in air, nitrogen and hydrogen respectively. In addition, experiments on the rate of chlorination of silver and previously insolated silver chloride are described, and these show that a maximum rate exists for certain concentrations of chlorine in air. No evidence of the existence of a subchloride was obtained.

ORIENTATION OF CRYSTALS IN METALS.—Two papers in the *Memoirs of the College of Science of the Kyoto Imperial University*, Ser. A, Vol. 8, No. 5, Aug. 1925, deal with the orientation of the crystals in cold-worked metals of the face-centred cubic type. The X-ray patterns obtained from platinum plates which have been cold-rolled from a thickness of 0·5 mm. to 0·03 mm. suggest that the majority of the crystals are so arranged that a dodecahedral face lies parallel to the rolled surface, the direction of rolling being perpendicular to a trigonal axis lying in this face. This ideal arrangement does not exactly hold for all the crystals, the dodecahedral planes of some being rotated slightly around the direction of rolling. In the case of gold leaf, the surface of the leaf is a cube face. A second investigation of the orientation of the crystals in cold-drawn aluminium wire suggests that a trigonal axis lies nearly parallel to the axis of the wire, the orientation being otherwise somewhat at random. The deviation of the trigonal axis from that of the wire is most generally about 7°. The exact amount of reduction in drawing is not given. An examination of a cold-drawn copper wire shows that the orientation of the crystals is identical with that in aluminium.

## Some Diseases of Cotton as seen in the Plantations.[1]

IN order to facilitate research work being carried out in the University of Manchester, for the Empire Cotton Growing Corporation, a visit was paid to some of the cotton states of America in the summer of 1924. The diseases of cotton described were observed in the plantations of North and South Carolina. In that season, according to recently published estimates by the U.S. Department of Agriculture, fungal and bacterial diseases of cotton reduced the crop in the U.S.A. by 1,900,000 bales. The extent of these losses in what was a relatively favourable season for cotton-growing indicates the importance of these diseases.

In the United States some diseases are more important than others, but, at the present time, all of them may be important to Great Britain in view of the considerable extension of cotton-growing in progress in various parts of the British Empire. In some of these countries a new crop plant is being introduced; we have little knowledge how it will react to its new environment and we do not know what diseases will appear. It is certain, however, that some diseases will occur, and it is well known that a disease which is relatively harmless in one country may become destructive in another. This may be illustrated by some of the diseases seen in the United States. *Bacterium malvacearum* causes the angular leaf spot and a boll disease on Upland varieties of cotton (*Gossypium hirsutum*), the leaves and bolls usually being the only parts of the plant affected. The Sea Island and Egyptian varieties of cotton (*G. barbadense* and *G. peruvianum*) are much more susceptible to the attacks of the organism, which also affects the leaf-stalks and branches, causing the "black arm" form of the disease. This "black arm" disease is already causing serious concern in the Sudan on Egyptian cotton, although in Egypt, presumably on account of the different climatic conditions, it is not troublesome. It is now known that infection may be carried on the seed, and seed-disinfection has proved successful in preventing the disease in the United States.

Again, in the U.S.A. several root-diseases of cotton occur. Of these the Texas root-rot (Ozonium) and the wilt disease caused by *Fusarium vasinfectum* are of most importance. In the latter case the disease was studied in South Carolina on badly infected soils. The fungus present in the soil passes into the conducting tissues of the plant and, excreting poisonous substances, leads to dwarfing, wilting and killing of the whole plant. In the Sudan a root-disease (the Tokar root-rot), undoubtedly different from the Fusarium wilts or Texas root-rot, but capable of stunting and killing the plant by progressive infection, is also causing trouble. Work at present in progress on this disease should ultimately determine its cause and probably provide for its control.

Diseases of the immature or opened bolls are commonly caused in the U.S.A. by *Glomerella gossypii* (anthracnose disease), Fusarium, Diplodia, and by *Bacterium malvacearum*. The cotton lint is destroyed, weakened or discoloured by such organisms. Similar boll diseases occur wherever cotton is grown, and recent studies by Mr. R. W. Marsh on discoloured cotton from Nyasaland have shown that the yellow discoloration is due to a species of Nematospora, a fungus. In the West Indies this fungus has been shown by Nowell to be inoculated into the bolls by cotton stainer bugs, which puncture the bolls as they feed. Stainer bugs were observed feeding on cotton bolls in South Carolina, but up to the present the Nematospora fungus is not known to cause disease of cotton in the U.S.A.

Other diseases of cotton studied were those caused by species of Alternaria and *Ascochyta gossypii*. These have not hitherto been of serious consequence in the United States, but the latter is now spreading and both diseases may prove much more harmful in other countries.

Of the diseases to which reference has been made, several have as yet been imperfectly studied, and only by extended work on such diseases and on the organisms responsible for them will it be possible for the growers and plant pathologists in cotton countries to guard against outbreaks of disease and to devise satisfactory means of control when such outbreaks occur.

[1] Substance of paper read before the Manchester Literary and Philosophical Society by Dr. Wilfrid Robinson on December 8.

## Causes of Volcanic Activity.

ON the occasion of the centenary of the Franklin Institute in 1924, Dr. A. L. Day delivered an address on volcanic activity, which appears in the journal of the Institute for August 1925. It is well known that the crater of Mauna Loa is 10,000 feet higher than the lava lake of Kilauea. Since more lava emerges from the higher vent than the lower, and eruptions rarely occur simultaneously, it is clear that the two vents cannot be connected with a continuous liquid interior. The changes of level of the lava of Kilauea would show periodic tidal effects if there were a molten cauldron underneath, but they fail to do so. Moreover, the lava lake was recently drained to a depth of 1500 feet, and a solid relatively cold bottom was exposed. A number of channels leading in from below were detected on the side walls.

Another firmly established conclusion is that the varying temperatures and fluidity of the lava are due to irregular uprisings of gases. These have evidently come from isolated chambers in which crystallisation is approaching completion, but at different stages from place to place. The gases pass up through various channels into the central basin, where they meet and react, and so produce the heat necessary to maintain the superficial vulcanism. The gases actually collected from the lava include hydrogen, chlorine, and sulphur, which, in association with others, make an unstable mixture that could not have come from any single source, since it is in a state of active exothermic reaction.

Modern volcanoes thus appear to be controlled by the liberation of gases from a crystallising mass below, and are very different phenomena from the fissure eruptions that gave rise to the great basalt plateaux of the Deccan and the Brito-Arctic region. The conclusion is amply confirmed by the study of the recent explosions of Lassen Peak, which were essentially due to the release of steam from a closed chamber of crystallising magma beneath the crater. Practically no chemically active gases were discharged, and consequently the temperature remained much lower than at Kilauea, and no lava was emitted.

No other North American volcano, and few in the whole world, have been investigated so thoroughly as Lassen Peak, and the magnificent memoir by Dr. A. L. Day and Dr. E. T. Allen (Carnegie Inst. of Washington, Pub. No. 360, 1925) dealing exhaustively with its activity in 1914–17 will take a high place in the literature of vulcanism. Lassen Peak began its life as a volcanic centre in early Neocene times, and has continued with diminishing violence down to the present day. It is now an old and dying volcano, for the explosive eruptions which began in 1914 followed a period of apparent extinction which had lasted at least two centuries. Only once during its four years of activity were red-hot ejecta witnessed, and it seems to be completely established that high temperatures, such as are attained at Kilauea or Vesuvius, played no part in the eruptions. The first explosions broke through the snow-filled crater basin, and open cracks developed, down which the melted snow disappeared. A year later a lid or plug of dacitic andesite was forced up the vent to the level of the old crater-rim, and just failed to rise sufficiently to expose the underlying volcanic hearth. A plane of weakness was formed, however, on the north-east side of the cone, and through this two devastating horizontal blasts forced a passage. The adjacent valleys were stripped of all vegetation for four miles, but no fires were started save momentarily where a few dead leaves were ignited. Trees were merely scorched. Solid ejectamenta embedded themselves in the snow without melting any appreciable quantity. The great floods that followed a day or two later were most probably caused by the condensation of superheated steam from the volcanic cloud.

The outburst seems to have been assisted by an earthquake that weakened the structure of the volcano, and also by the flowing of water from melted snow down the first-formed cracks. But though this water must have participated in the tremendous steam-explosions that followed, it can scarcely have been an essential contributory cause, for the violence of the eruptions increased long after the snow had gone, and quantitatively it was inadequate to account for the enormous volumes of steam that escaped during the 300 or more explosions that afterwards occurred. Another source for the steam must therefore be postulated. The authors suggest that the gases responsible for the explosions were for the most part in solution in the crystallising magma beneath the crater, water being by far the most abundant ingredient of these volatile constituents.

It is now well known that a silicate magma can hold a considerable quantity of water in solution under appropriate conditions. G. W. Morey has pointed out (*Journ. Washington Acad. Sci.*, vol. 12, p. 219, 1922) that as crystallisation proceeds with falling temperature, the pressure of the volatile constituents increases at a rapid rate. This deduction from laboratory experience and thermodynamical reasoning goes far towards elucidating, not perhaps the entire problem of vulcanism as Dr. Day claims, but certainly most of the superficial phenomena of present-day volcanoes. The discharge of water during crystallisation must develop immense pressures when it takes place in a closed cauldron. The pressure may find relief in a single tremendous explosion, as in the case of Bandai San; or intermittently, as at Mt. Pelée or Lassen Peak, according to the rate of release of the water, and the roof conditions permitting or resisting its active escape. That the water-content of magmas before crystallisation is greater than that of crystallised rock is proved by the high percentage of water which is retained by obsidians and pitchstones.

The concluding sentences of Dr. Day's address summarise a long and consistently sustained argument: "Through all of these studies our conclusion seems to stand fast wherever it is applied, namely, that the outstanding factor in determining the character of modern vulcanism is the gas content of the crystallising magma. If this be mainly of steam released in a closed chamber, as at Lassen Peak, then only steam explosions are to be expected as the surface manifestation of the crystallisation of the magma below; if to the steam are added such chemically active gases as chlorine, sulphur, hydrogen and the hydrocarbons, then chemical reaction between these will be a sufficient cause of higher temperatures, and lava flows of the character well known at Vesuvius, Stromboli or Kilauea." ARTHUR HOLMES.

## Diseases of the Hop.

A NUMBER of interesting communications have recently appeared dealing with diseases of the hop. In particular a paper by E. S. Salmon and W. M. Ware (*Annals of Applied Biology*, 1925, 12, 121) discusses in detail a downy mildew which was first found in Europe in 1920 at the experimental hop gardens of Wye College. Since that year the intensity of the disease has been increasing rapidly, and it may become a serious factor in hop production in the future.

Previous to 1920 the disease was observed in Japan in 1905 (*Pseudoperonospora Humuli* (Miyabe and Takah.) Wils.) and in the United States in 1909, and there appears to be little doubt that the three diseases are identical. In 1923 the opinion was expressed that the fungus causing the disease had been imported into Great Britain from one of the countries mentioned, but subsequent work has led to the conclusion that it is indigenous. The downy mildew which is common to the nettle, *Peronospora Urticæ* (Lib.) de Bary, has been found to differ only as regards the size of the oospore from that occurring on the hop, and cross-inoculation experiments have led to the suggestion that the fungus may be transferred from one to the other. This is supported by the fact that infected nettles have often been found in close proximity to infected hops. Assuming then that the fungus from the nettle has found a new host, it would seem that the chance of infection becomes greater in a wet than in a dry season. This might account for the great increase in infection during the particularly wet season of 1924. On the other hand, a process of evolution may be taking place in which the hop is being infected by new forms of the downy mildew of the nettle, and in this case the prospect is rather more serious. Consequently the results of investigations during the 1925 season will be awaited with great interest.

It may also be mentioned that a similar disease has recently been noted for the first time in Germany, and as the nettle mildew is known to occur in the hop-growing districts of that country, some light may be shed on the problem from this quarter.

The disease is characterised by the appearance on the hop leaf of reddish-brown angular spots. Under the microscope these can be seen to consist of hair-like growths, which differ from ordinary hop mildew in that they are branched instead of unbranched. The branches bear conidia which drop off and spread the disease by germination in the presence of water. The hop cones may also be attacked, in which case the whole cone may turn brown and wither.

These symptoms must not be confused with those arising as a result of the "browning of cones" disease which in recent years has attacked hops on the Continent. This disease is also characterised by a shrunk epidermis which contains a reddish-brown substance, and has been ascribed by Wagner (*Tageszeit. Brau.*, 1924) to the exceptionally unfavourable weather conditions of 1924, rather than to a particular organism. P. Lindemanns (*Pet. Jour. du Brass.*, 1925, 33, 189) has stated that the disease was due to lack of nourishment of the cones. This was a result of the insufficient supply of sap, the transpiration being checked by the excessive humidity of the atmosphere. Thus, when the rows of hops had been planted in the direction of the prevailing winds, the disease was less marked than in the case of plants from damp and low-lying parts. J. G.

## University and Educational Intelligence.

CAMBRIDGE.—Mr. R. E. Priestley has been appointed Assistant Registrary with the duties of Secretary to the Boards of Examinations and Research Studies. Mr. Priestley was a member of two Antarctic Expeditions; he entered the University as a research student in geology in 1913; became a fellow of Clare College in 1923 and has been secretary to the Board of Research Studies for two years.

Two lists of successful candidates in the recent scholarship examinations have been published. An analysis of the awards of open scholarships and exhibitions shows that 35 are for natural science, 42 for mathematics and 113 for other subjects—classics, history, languages, etc. A further point of interest lies in the distribution of the successful candidates among the schools. It is often nowadays no easy matter to decide whether any place of secondary education is a "public school" in the generally accepted sense of the term. It is possible, however, to draw up an arbitrary list which will include those schools which the majority of educated people would call "public schools." The present writer has ventured to construct such a list, and has grouped the new scholars and exhibitioners according to it. The following figures have been obtained.

| | Nat. Sci. | Math. | Other Subjects. |
|---|---|---|---|
| From Public Schools . | 11 | 21 | 65 |
| From other Secondary Schools . . . | 24 | 21 | 48 |

Any deductions made from these figures are liable to severe criticism, but three hypotheses suggest themselves:

(1) The public schools divert the majority of their best scholars in directions other than scientific ones.
(2) The teaching of "other subjects" in the public schools is superior to instruction in them in the other schools.
(3) The teaching of science in other schools is generally superior to that in the public schools.

It is commonly believed in Cambridge that (3) is certainly partially correct in many cases. Perhaps it is time that the public schools gave the matter further thought.

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ACCORDING to the report recently issued by the Secretary of the Rhodes Trust, the number of Rhodes Scholars in residence during the year 1924–1925 was 185, of which 96 were from the British Empire and 89 from the United States; 63 took up their scholarships for the first time. The present academic year started with 185 scholars in residence. From the table showing the distribution among subjects during the past year, it appears that 48 were taking natural science and medicine and 2 mathematics. Five Rhodes Scholars were awarded the degree of D.Phil., three of them being natural science students. Reference is also made to distinctions gained by former Rhodes Scholars, among whom are R. B. Brode, awarded a research fellowship by the National Research Council of America; H. W. Florey, appointed to a Rockefeller medical fellowship; and E. P. Hubble, who was awarded half the American Association for the Advancement of Science Prize for 1924 for his researches on nebulæ. Notice was received during the year of no less than 33 new books by Rhodes Scholars, of which only 4 have a bearing on science. The scholarships are to continue to be of the annual value of 400*l.* each. A site has been purchased at Oxford for the erection of a building to be known as "Rhodes House," which will be the residence of the Oxford secretary and will contain a library and a hall for the annual dinners of the Trust. Information as to the scholarships may be obtained from the offices of the Trust, Seymour House, Waterloo Place, London, S.W.1. In the United States application may be made to President Aydelotte, Swarthmore College, Swarthmore, Pennsylvania; in Canada to Mr. J. M. Macdonnell, National Trust Company, Limited, Montreal, P.Q.; in Australia to Dr. J. C. Behan, Trinity College, Parkville, Victoria; in South Africa to Mr. P. T. Lewis, Court Chambers, Keerom Street, Cape Town.

APPRENTICES in H.M. Dockyards have to attend school for a certain number of hours each week, and any one who knows the Dockyard schools and the instructors in them is not surprised at the successes of the students, for no better scientific and technical education for youths is given anywhere in Great Britain. As, however, the apprentices are educated at the public expense with the view of their becoming shipwrights or fitters in the Dockyards, and as they have many decided advantages over students in technical schools outside, it seems scarcely just that they should be able to use these advantages to secure scholarships intended for science students generally. Judging from the list, just issued by the Board of Education, of successful candidates for Royal Scholarships and Free Studentships, and from the latest list of awards of Whitworth scholarships, there is little prospect of success for any candidate who has not been educated in a Dockyard school, particularly for scholarships in engineering subjects. Thus, there were seventy-one competitors for Group A (Engineering) for Royal Scholarships and Free Studentships in the 1925 examination, and each of the eleven successful candidates was a Dockyard apprentice. In the other groups—physics, chemistry, biology, and geology—all the successful candidates were from schools and colleges not in the Dockyards. Nearly all the Whitworth scholars in the last list were from the Dockyard schools, and so it has been for several years. This must be discouraging to teachers and students in other technical schools and colleges, and we suggest that the Board of Education might well give attention to the matter with the view of arriving at a more equitable adjustment of the awards. It was never intended that Royal and Whitworth Scholarships should be a special reserve for students in such institutions as H.M. Dockyards, where exceptional opportunities of preparing for them are enjoyed, both as regards the advantage of being given school time in working hours and as regards the practical and theoretical instruction afforded.

## Contemporary Birthdays.

January 9, 1866. Prof. Charles J. Martin, C.M.G., F.R.S.

January 12, 1862. Prof. John G. Adami, C.B.E., F.R.S.

January 13, 1842. Sir Alfred F. Yarrow, Bart., F.R.S.

January 13, 1843. Sir David Ferrier, F.R.S.

January 13, 1858. Sir D. Orme Masson, K.B.E., F.R.S.

January 13, 1869. Sir Richard Paget, Bart.

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Prof. J. G. ADAMI, Vice-Chancellor of the University of Liverpool, was born at Manchester. Educated at Owens College in that city, he entered Christ's College, Cambridge, in 1880. In 1887 he became a demonstrator of pathology in the University, and afterwards John Lucas Walker student of pathology. Prof. Adami was appointed Strathcona professor of pathology and bacteriology, McGill University, Montreal, in 1892, this post leading to important developments and highly appreciated issues of work whilst in Canada. President of the Canadian Association for the Prevention of Tuberculosis, 1909–12, he was president of the Association of American Physicians, 1911–12. Prof. Adami has written much on the nature of inflammatory processes. A joint paper with the late Dr. C. S. Roy, "Contributions to the Physiology and Pathology of the Mammalian Heart," was published in the *Philosophical Transactions of the Royal Society*.

Sir ALFRED YARROW was born in London in 1842. Our cordial congratulations are offered on the occasion of his eighty-fourth birthday. He was educated at University College School, London. Beginning business as a shipbuilder and engineer at Poplar, he migrated to Clydeside in 1906, continuing, as the founder of the world-renowned firm which carries his name and flag, the building of merchant ships and supplying the multifarious requirements of British Navy craft. An early and generous benefactor to the National Physical Laboratory, the wider demands of science in general have found aid and maintenance through his munificence. So recently as 1923 Sir Alfred made a gift of 100,000*l*. to the Royal Society for administration as a research fund.

Sir DAVID FERRIER, emeritus professor of neuropathology, King's College, London, was born at Aberdeen in 1843, and thus has reached the ripe age of eighty-three years. Graduating at Aberdeen in 1863, he studied as well at the Universities of Edinburgh and Heidelberg. Sir David is specially identified with researches on the localisation of cerebral functions, begun fifty years or more ago. In presenting one of the Royal Society's Royal medals to him in 1890, the then president recorded that "we owe to Prof. Ferrier's experiments in monkeys, animals which he was the first to use for this purpose, the beginning and indeed the greater part of our knowledge of cerebral localisation in man. Broca located the centre for speech in the third left frontal convolution, but with this exception nothing was known of cerebral localisation in man until Ferrier commenced his experiments in 1873." By experiments upon monkeys Ferrier was able to map out the most important motor areas with great precision, and the results were eventually turned to practical account in cerebral surgery.

## Early Science at Oxford.

January 11, 1683–4. A letter from Mr. Aston mentioned an Analysis of ye stone of ye bladder, given in to ye Royall Society, by Mr. Lister; who affirms, that ye Lapidescent juices within ye body, are ye same with those which are without it; and that ye *Caput mortuum* of ye stone, will apply to a Magnet, like other pyrites.

The Minutes of what has passed in ye new Society of Dublin were read; They gave an account of severall discourses, of a differing nature, which have been read at their meetings; Wee shall in a little time, have copies of them. It was then ordered, that thankes should be return'd to ye gentlemen of that Society for ye favor of their correspondence; and that ye Minutes of this Society should constantly be sent them.

An account was given of severall late distillations of brine, made by Dr. Plot and Mr. Musgrave.

1686–7. Mr. Pit communicated an account of the peristaltic motion of the stomach, observed in a dog in July 1685 and also of lacteals arising from the stomach. He was desired to try if he could discover any lacteal veins in Birds.

January 12, 1685–6. Mr. Flamsteed's Tide-Table for ye year 1686 was presented to ye Society, and Mr. LLoyd presented a Catalogue of ye Shells in ye Musæum Ashmoleanum.

Dr. Plot communicated a Table for ye keeping a Diary of Weather-journall by observing ye station of ye quicksilver in ye Baroscope, ye place of ye Spirits in ye Thermometer, the points and strength of the Wind; and ye state of ye Weather: together with an account of Weather-glasses exactly made and sold (as the table also is) by Mr. Jo: Warner, London.

January 13, 1684–5. Dr. Smith (in ye chair, in ye absence of ye President,) acquainted ye Society, that according to a MS. of Julius Africanus, belonging to Magdalen Colledge, (which MS. he thinks is about 200 years old,) ye citation of Vossius out of this Author, concerning ye making of Ignis Græcus, is exact.

A Cubicall measure, of a Quantity given, was proposed to be provided; Mr. Caswell, and Mr. Walker were desired to enquire, concerning ye making one; with it ye difference as to weight, between ye same measure of severall sorts of substances, as grains, earths &c of diverse kinds, may be examined, and ye quantity of water &c: exhaling from a given space, in a time given, may be found out; an account of which will make much toward ye clearing this quere, viz whether the water of ye Mediterranean is disposed of by way of vapor?

According to Mr. Charles Leigh, they have in the County of Lancashire an earth, never yet plowed in ye memory of man, in which (about 2 yards under ye surface) he has found severall grains of corn, not in ye least rotted; he has seen trees in it perfectly sound; it will preserve any kind of flesh; and (he thinks) it may make compleat Mummies.

He says, they have a Tobacco-pipe clay, which will dissolve in water, and take out any spot: that they have a fish, which (he thinks) is the sepia; for if they offer to catch it, it will immediately make ye water look as black as ink. Another fish in that Countrey, has a prickle on its back; with which, if the seamen are at any time prickt, ye part will certainly gangrene; this prickle, he says, is hollow, and is inserted into a little bladder, out of which ye poyson proceeds, after ye same manner as in Vipers.

Mr. Welsteed communicated an account of making turpentine, tar, rosin, and pitch near Marseilles, by Mr. Tho: Bent M.A. lately of Lincoln College.

## Societies and Academies.

LONDON.

**Geological Society**, December 16.—W. D. **Lang** and L. F. **Spath**: The black marl of Black Ven and Stonebarrow, in the Lias of the Dorset coast. Pt. I. (W. D. L.). The Black Marl Series of the Geological Survey includes Oppel's zones of *obtusus*, *oxynotum*, and *raricostatus*. The lowest part of the series—the Shales-with-Beef, has already been described in detail. At least twelve horizons can be recognised in the Black Marl above the Shales-with-Beef; as well as two non-sequences. Pt. II. (L. F. S.). New species of ammonites from the Black Marl are described. Notes are also added by Dr. A. E. Trueman on the Echioceratid ammonites; by Mr. L. R. Cox on the lamellibranchs; and by Miss H. M. Muir-Wood on the brachiopods.

EDINBURGH.

**Royal Society**, December 21.—Sir J. J. **Thomson**: The intermittence of electric force. It is supposed that when a body is under the action of such a force, the increments it receives are each finite in amount and separated by finite intervals of time, the average interval of time being called the time interval of the electric field. For events which last over a large number of time intervals the results are the same as those given by the Classical Theory of continuous force, but for events which can happen in the very short time comparable with the time interval of field an entirely different treatment is required. The path of an electron in an electric field would on this view not be a curve of continuous curvature, but an irregular polygon with a very large number of sides. The intermittence of electric force would lead to some spontaneous dissociation of systems consisting of electrons and positively charged particles, and to the production of Röntgen rays when electrons passed near atoms, but these rays would be very soft unless the electrons moved so quickly that the time they were in the neighbourhood of the atom was comparable with the time interval of the electric field in the atom. Since the time interval gets longer as the strength of the electric field diminishes, periodic electric waves cannot spread out indefinitely into space, for as they travel outwards the intensity of the electric field diminishes and ultimately gets so weak that its time constant is long compared with the period of the waves; the waves will be reflected back at this stage and thus the energy will be confined to a limited volume, and the shorter the period of the waves the smaller will be this volume. This shows that the energy of light must travel in bundles which do not spread out as they travel through space. The conception simplifies the dual theory of light recently brought forward by the author, as it ensures that the energy of the electrical waves in the unit of light should be constant as well as the energy of the quantum.—A. R. **Forsyth**: A chapter in the calculus of variations: maxima and minima for weak variations of integrals involving ordinary derivatives of the second order. The paper constructs the tests for the possession of a maximum or a minimum, by integrals that involve first and second derivatives of an unknown quantity. The curve, representing the relation between the dependent variable and the independent variable, is subjected to completely arbitrary variations throughout its length, these being small in magnitude as regards position, direction, and curvature. The tests are sufficient, as well as necessary, for the small variations specified.—A. C. **Aitken**: On the theory of graduation. A paper dealing with Prof. E. T. Whittaker's theory of the graduation of data. A new method of solution is proposed which is better adapted for computation and also brings out a comparison with other extant methods of graduation.—C. E. **Weatherburn**: On triple systems of surfaces and non-orthogonal curvilinear co-ordinates.

SHEFFIELD.

**Society of Glass Technology**, December 16.—W. E. S. **Turner**: The composition of glass suitable for use with automatic machines. A survey was made of the whole field of glass compositions which have been used, particularly for glass bottles, from the time of the Roman glass makers down to the present day. The introduction of the automatic machine has much limited the range of compositions available. For example, in using a number of types of machines the percentage of lime in the glass cannot be raised safely above 10 per cent., whereas in some of the glass used on the continent and worked by hand 20 per cent. sometimes occurs. The factors which decide the limits of composition are the size of the article, whether colourless or coloured; the method by which the machine is to be charged, that is to say, whether by suction or by gob feeding; and finally by the type of machine itself. Scientifically, the factors of importance are the viscosity of the glass, the rate at which the viscosity changes with temperature, the heat conductivity and heat radiation.—Violet **Dimbleby** and W. E. S. **Turner**: The relationship between the durability and the chemical composition of glass. Tests were made of glasses of similar type in which soda was replaced successively by lime, magnesia, alumina, titania, zirconia, barium oxide and boric oxide. In all, 70 to 80 individual glasses were prepared, and the action of the four reagents, namely, boiling water, hydrochloric acid, sodium carbonate and caustic soda solution, were tested.

CAPE TOWN.

**Royal Society of South Africa**, October 21.—P. R. v.d. R. **Copeman**: Note on the decrease in acidity during the ripening of grapes. The most important changes occur in the sugar and acid content of the juice. The acidity, as determined by titration, decreases during ripening, and when the logarithm of the acidity is plotted against the time, a straight line is obtained. The concentration of acid varies with the time, and the rate of decrease is proportional to the existing concentration. The acidity at any given time depends upon the variety of grape. The rate of decrease of acidity is independent of the variety, but is dependent upon some seasonal variation. The rate at which grapes ripen during any given season is independent of the variety. At maturity the decrease in acidity becomes practically negligible.—Alexander **Brown**: An extension of Ceva's theorem to polygons of any number of sides. For a polygon of $2m$ sides it gives $m-1$ relations, and for a polygon of $2m+1$ sides it gives $m$ relations. Various special results already known can be derived as particular cases.—L. P. **Bosman**: The hydrolytic properties of certain amino-acids. Falk and Nielson state that the amino-acids glycine, alanine, leucine, aspartic and glutamic, bring about the hydrolyses of esters such as methyl acetate, ethyl butyrate, and olive oil. The actual hydrolyses cannot, however, be attributed to the fact that these acids contain the amino-group. The acidity of the medium seems to be the cause of the hydrolyses.—D. B. **Swart**: Note on the South African marine mussel, *Mytilus Meridionalis*, Krauss (1848). *M. Meridionalis* is established beyond all doubt as a distinct species.—H. G. **Fourcade**: (1) On instruments and methods for stereoscopic surveying. (2) The optical transformation of projections and its application to mapping from air photographs. (3) On some conditions for the accurate vision of stereoscopic pictures.

ROME.

**Royal Academy of the Lincei**, November 1.—G. **Armellini**: An apparent oscillation of the solar diameter. Experiments carried out in the Royal Campidoglio Observatory. Measurements made in three Italian observatories in 1924 give, for the sun's diameter, values lower than those obtained in 1923. Support is thus furnished to Hilfiker's and Lane's hypothesis that the sun is a pulsating star.—F. **Zambonini** and G. **Carobbi**: Double sulphates of the rare earth and alkali metals (iii.). Double sulphates of lanthanum and sodium. Investigation of the isotherm for 25° indicates the formation of the stable compound, $La_2(SO_4)_3$, $Na_2SO_4$, $2H_2O$.—F. **Zambonini** and R. G. **Levi**: Researches on the isomorphism of the molybdates of rare earth metals with those of calcium, strontium, barium, and lead. Röntgenographic analysis shows that the compounds $CaMoO_4$, $SrMoO_4$, $BaMoO_4$, and $PbMoO_4$ possess identical crystalline structures.—Mineo **Chini**: Plane lines, for which the length of the arc is given in polar coordinates, as a function of the anomaly of the extremity.—G. C. **Evans**: The simple potential, and Neumann's problem.—Mentore **Maggini**: The orbit of the binary system OΣ 535, deduced from interferometric measurements.—V. **Ronchi**: The ocular interferometer.—Rita **Brunetti**: The effect of chemical linking on the energy of intra-atomic levels.—A. **Pontremoli**: The orientation in a constant electric or magnetic field in the hypothesis of molecular anisotropy.—L. **Tieri**: Determination of Avogadro's constant by means of doubly refracting solutions of dialysed iron. Results are obtained which show that even liquids which under the ultramicroscope appear to contain in suspension granules of only one type, actually contain granules of different magnitudes. There results, therefore, increased condensation of the granules at the bottom of the liquid, and consequently, for the lower layers, greater double refraction than corresponds with Laplace's law.—Luigi **Rolla** and Giorgio **Piccardi**: Chemical statics of electronic phenomena.—Mario **Amadori**: Products of the condensation of glucose with *p*-phenetidine.—Michele **Giua**: Influence of substituents on the formation and stability of various cyclic compounds. In connexion with the nuclear tension of coumaranone and coumarandione compounds, the condensation of malonyl chloride with $\beta$-naphthol has been investigated.—Pietro **Saccardi**: The nature of melanogen. When injected into the animal organism, pyrrole does not pass unaltered into the urine, but is converted by oxidation in the organism into a melanogen which yields an azo-compound different from that furnished by pyrrole.—Tullio **Carpanese**: The epidote of Monte Rosso di Verra (Monte Rosa group). This mineral, of specific gravity 3·343, exhibits the crystallographic constants, $a : b : c = 1{\cdot}5803 : 1 : 1{\cdot}8045$, $\beta = 64° \ 34{\cdot}5'$, and a composition in good agreement with the formula $HCa_2(Al, Fe)_3 Si_3O_{13}$.—Cesare **Artom**: Obligatory correlations of true tetraploidism (giantism and cellular magnitude).—Gustavo **Brunelli** and Ettore **Remotti**: The physiologico-etiological significance of the secondary sexual characters in Gambusia.

SYDNEY.

**Royal Society of New South Wales**, November 4.—J. C. **Earl** and V. M. **Trikojus**: The constitution of australol. The identity of the solid phenol, australol, isolated from certain eucalyptus oils by the late Mr. H. G. Smith, with *p*-isopropyl phenol, has been established. For the purpose of comparison, *p*-isopropyl phenol was prepared synthetically by the following scheme of reactions: magnesium phenyl bromide + acetone ⟶ phenyl methyl carbinol ⟶ isopropenyl benzene ⟶ cumene ⟶ sodium cumene *p*-sulphonate ⟶ *p*-isopropyl phenol.—A. R. **Penfold**: The essential oils of *Melaleuca linariifolia* and *M. alternifolia*. Both these tall papery-bark tea trees follow the water-courses of the coast districts of N.S. Wales and southern Queensland, the former being abundant around Sydney, whilst the latter is plentiful at Copmanhurst on the Clarence River. Terpinenes, cymene, d-a-pinene, cineol, sesquiterpenes (cadinene), and terpinenol-4, with a little sesquiterpene alcohol, are the principal constituents of the essential oils.—Leo A. **Cotton**: Note on the earthquakes at Murrambateman during March and April 1924, and January to April 1925. Although the continent of Australia lies outside the two great earthquake belts of the world in which 95 per cent. of all recorded shocks occur, there are certain areas which are subject to occasional earthquakes. The Yass district is one which has from time to time been shaken, but there is no previous record of such a seismic spasm as that which affected this district during the months of March and April 1924. Altogether some nine or ten shocks were recorded in this interval. The first earthquake was the most pronounced, and the information secured from many residents in the district show that the isoseismals have a pronounced L-shaped distribution which is attributed to movement along two faults which act as partial boundaries of an unstable earth block. A recurrence of seismic activity in the district took place during the period January to April in the following year (1925). Five shocks were recorded in this interval.—M. B. **Welch**: The identification of the principal ironbarks and allied woods. Australia's most valuable hardwoods for heavy constructional work, railway sleepers, poles, etc., are the ironbarks. It is, however, very difficult to separate these woods from certain timbers known as grey gum, which are often substituted for the former. Certain differences exist, however, and these are described.

## Official Publications Received.

Sixth Report of the Smoke Abatement League of Great Britain. Pp. 17. (Manchester: 33 Blackfriars Street.)

Contributions to Palaeontology from the Carnegie Institution of Washington. Papers concerning the Palaeontology of the Pleistocene of California and the Tertiary of Oregon. (Publication No. 347.) Pp. iii+92+10 plates. (Washington: Carnegie Institution.)

Archaeological Investigations in the Aleutian Islands. By Waldemar Jochelson. (Publication No. 367.) Pp. ix+145+28 plates. (Washington: Carnegie Institution.)

United States Department of Agriculture. Department Bulletin No. 1339: The Effect of Weather upon the Change in Weight of a Colony of Bees during the Honey Flow. By James I. Hambleton. Pp. 52. (Washington: Government Printing Office.) 10 cents.

Livingstone College. Annual Report and Statement of Accounts for the Year 1924–25. Pp. 24. (Leyton, E.10.)

New Zealand: Department of Lands and Survey. Scenery Preservation: Report for the Year ended 31st March 1925, together with Statement of Accounts and Schedule of Lands acquired and reserved during the Year under the Scenery Preservation Act. Pp. 7. (Wellington, N.Z.: W. A. G. Skinner.) 6*d*.

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 29, Part 2, Session 1924–25. Pp. xvi+119-217. (Edinburgh.) 7*s*. 6*d*.

Proceedings of the Royal Society of Edinburgh. Session 1925–1926. Vol. 46, Part 1, No. 1: Some Modern Aspects of Physical Research. Address by the President, Sir Alfred Ewing. Pp. 8. 9*d*. Vol. 46, Part 1, No. 2: Prenatal Death in the Pig and its Effect upon the Sex-Ratio. By F. A. E. Crew. Pp. 9-14. 6*d*. (Edinburgh: R. Grant and Son; London: Williams and Norgate, Ltd.)

Communications from the Geological Institute of the Agricultural University, Wageningen (Holland). No. 9: Report on a Collection of recent Shells from Obi and Halmahera (Moluccas). By Dr. C. H. Oostingh. Pp. 363. (Wageningen: H. Veenman en Zonen.)

New Zealand: Dominion Museum. Bulletin No. 9: Maori Agriculture; the Cultivated Food Plants of the Natives of New Zealand, with some Account of Native Methods of Agriculture, its Ritual and Origin Myths. By Elsdon Best. Pp. viii+172+27 plates. (Wellington, N.Z.)

Forest Bulletin No. 67 (Silviculture Series): Chir (Pinus longiflora) Seed Supply. By S. H. Howard. Pp. 7. (Calcutta: Government of India Central Publication Branch.) 3 annas; 4d.

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 14: Regenval in Nederlandsch-Indië (Rainfall in the Netherlands Indies). Door (by) Dr. J. Boerema. Deel 1 (Vol. 1): Gemiddelden van den Regenval voor 2715 Waarnemingsplaatsen in Nederlandsch-Indië, berekend uit Waarnemingen verricht in het Tijdvak 1879–1922 (Mean Rainfall Figures for 2715 Rainfall Stations in the Netherlands Indies, calculated from Observations made during the Period 1879–1922). Pp. viii+192. (Weltevreden: Landsdrukkerij.)

The American Museum of Natural History. Guide Leaflet No. 61: The Capture and Preservation of Small Animals for Study. By H. E. Anthony. Pp. 53. (New York.) 15 cents.

## Diary of Societies and Public Lectures.

*SATURDAY*, JANUARY 9.

GEOGRAPHICAL ASSOCIATION (Annual Meetings) (at London School of Economics), at 9.30 A.M.—Exhibition.—At 10.—Prof. P. M. Roxby: The Concept of Natural Regions in the Teaching of Geography, with Special Illustrations from China.—At 11.15.—Discussions held concurrently in separate rooms:—C. G. Beasley and others: The Place of Geology in a Two Period a Week Geography Course.—C. D. Forde and others: Detail in Geography Lessons.—Major A. G. Church and others: Geography in Relation to other School Subjects.—Miss R. M. Fleming and others: Geography for the Younger Children in Primary Schools.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Town Hall, Huddersfield), at 2.30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Old Trades and New Knowledge: (6) The Trade of the Miner.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 4.—J. Longden: Liquid Shrinkage in Grey Iron.

*MONDAY*, JANUARY 11.

ROYAL IRISH ACADEMY, at 4.15.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Prof. A. A. Lawson: Endemism and Evolution as observed in the Australian Flora.—Prof. G. Harrower: A Study of the Hokien and Tamil Skull.—Dr. D. A. Fairweather: Electrosynthesis in the Series of Normal Dibasic Acids.—Miss C. C. Miller: The Slow Oxidation of Phosphorus Trioxide, Pt. 1. The Action of Water Vapour on Phosphorus Trioxide.—E. T. Copson: Partial Differential Equations, and the Calculus of Variations.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Prof. T. G. Pinches: Notes on the Discoveries at Ur and Tel Al-Obeid, and the Worship of the Moon-God.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Chamber of Commerce, Birmingham), at 7.—H. Briggs: The Elimination of Noise in the Motor Cycle.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) (at University College), at 7.—W. C. Clinton and others: Discussion on The Electrical Installation at the Rockefeller Building, University College.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7.—E. H. Lewis: The Reduction of Factory Costs.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Prof. F. C. Thompson: The Mechanical Properties of Non-Ferrous Metals and Alloys at High Temperatures.

SURVEYORS' INSTITUTION, at 8.—W. L. Taylor: Recent Forestry Development.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—J. P. Mills: The Assam-Burma Frontier.

ROYAL SOCIETY OF MEDICINE, at 8.30.—Prof. Noël Paton: The Metabolic Changes in Chloroform Poisoning.

INSTITUTE OF BREWING (London Section) (at Engineers' Club, Coventry Street, W.).—J. Stewart: Barleys.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Swansea).—R. A. Chattock: Presidential Address.

*TUESDAY*, JANUARY 12.

MANCHESTER GEOLOGICAL AND MINING SOCIETY, at 4.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology and Medicine Sections), at 5.—Prof. Elliott and Prof. Cummins and others: Discussion on The Treatment of Pulmonary Tuberculosis with Sanocrysin.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—J. Stanley Lewis: The Vapour Pressures of Fuel Mixtures, Part II., to be followed by a discussion, opened by Prof. J. S. S. Brame, on The Estimate of Unsaturated and Aromatic Hydrocarbons.

INSTITUTION OF CIVIL ENGINEERS, at 6.—C. F. Bengough: High-Level Bridge, Newcastle-upon-Tyne: Underpinning and Repair of Foundations of River Piers.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.—H. M. Sayers: Electricity Supply Tariffs.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—A. S. Watson: The Influence of the Renaissance on Italian Painting.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at Broadgate Café, Coventry), at 7.30.—J. D. Parkes: Logic applied to Failures.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cathays Park, Cardiff), at 7.30.—Discussion on The Training of Chemists for Industry.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Prof. W. Kerr: Failure of Metals by Creep.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—T. Savory: Evolution in Spiders.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.—F. Browne and Dorothy G. Randle: Some New, Modified and Tested Formulæ of the British Pharmaceutical Codex.

*WEDNESDAY*, JANUARY 13.

ROYAL SOCIETY OF ARTS, at 3.—Prof. H. E. Armstrong: Alice in Wonderland at the Breakfast Table (Mann Juvenile Lectures) (2).

ROYAL SOCIETY OF MEDICINE (Surgery: Sub-Section of Proctology), at 5.30.—Dr. C. Dukes: Simple Tumours of the Large Intestine and their Relation to Cancer. (To be followed by a discussion.)

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—F. J. Paice: The Testing and Examination of Materials for Railway Construction.

RADIO SOCIETY OF GREAT BRITAIN (Informal Meeting) (at Institution of Electrical Engineers), at 6.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—C. E. Webb: The Power Losses in Magnetic Sheet Material at High Flux Densities.

INSTITUTION OF CHEMICAL ENGINEERS (jointly with Society of Chemical Industry (London Section)) (at Chemical Society), at 8.—A. J. V. Underwood: A Critical Review of Published Experiments in Filtration.—Dr. G. Martin: Tube Mill Grinding—with special reference to Grinding in a Current of Air.

INSTITUTION OF ENGINEERS-IN-CHARGE (at St. Bride Institute, Bride Lane, E.C.), at 8.—J. W. L. Rowe: Industrial Economics.

INSTITUTION OF STRUCTURAL ENGINEERS (Lancashire and Cheshire Branch).—Prof. J. Husband: The Lateral and Transverse Bracing of Bridges.

*THURSDAY*, JANUARY 14.

ROYAL SOCIETY, at 4.30.—Dr. L. Hill and Y. Azuma: Effects of Ultra-Violet Radiation upon Involuntary Muscle and the supposed Physiological Interference of Visible Rays.—I. de B. Daly: A Closed Circuit Heart Lung Preparation. Effect of Alterations in the Peripheral Resistance and in the Capacity of the Circulation.—*To be read in title only*:—T. S. P. Strangeways and Honor B. Fell: Experimental Studies on the Differentiation of Embryonic Tissues growing *in vivo* and *in vitro*. I. The Development of the Undifferentiated Limb-bud (*a*) when subcutaneously grafted into the Post Embryonic Chick, and (*b*) when cultivated *in vitro*.—C. N. Long: Muscular Exercise, Lactic Acid, and the Supply and Utilisation of Oxygen. Part XIV. The Relation in Man between the Oxygen Intake during Exercise and the Lactic Acid Content of the Muscles.—K. F. Hetzel and C. N. Long: The Metabolism of the Diabetic Individual during and after Muscular Exercise.—W. G. Millar: The Diffraction Method of measuring the Diameter of Erythrocytes.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at University College), at 6.—Miss Margaret Drummond: The Nature and Training of the Imagination.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—W. M. Mackay: Atmospheric Electricity.

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch) (Annual Meeting) (at Royal Technical College, Glasgow), at 7.30.—S. Couper: Economy of Fuel in Steam Generating Installations.

INSTITUTION OF MECHANICAL ENGINEERS (Cardiff Branch) (Annual Meeting).

INSTITUTION OF MECHANICAL ENGINEERS (Liverpool Branch).—Third Report of the Marine Engine Trials Committee.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

INSTITUTION OF THE RUBBER INDUSTRY (Manchester Section) (at Manchester).—H. C. Young: Steam and its Control as applied to Rubber Production Methods.

*FRIDAY*, JANUARY 15.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—Prof. J. Joly: Radioactivity and the Earth's Surface History. Other speakers: Dr. H. Jeffreys and P. Lake. In chair—Lord Rayleigh.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Discussion: Novelties at the 1925 Engineering Exhibition.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—A. C. Banfield and J. D. Johnston: Demonstration of Thiocarbamide Lantern Slide Making.

PHOTOMICROGRAPHIC SOCIETY (at 20 Mortimer Street) (Members only), at 7.—J. W. Ogilvy: Demonstration of Recent Improvements in Microscopical Apparatus.

INSTITUTE OF METALS (Swansea Local Section) (at University College, Swansea), at 7.15.—Prof. F. C. Thompson: The Wire-Drawing Process.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. Wolstenholme: The Commercial Side of Foundry Work.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—Prof. C. H. Desch: The Early History of Gold.

INSTITUTION OF STRUCTURAL ENGINEERS (Midland Counties Branch) (at Birmingham), at 7.30.—W. E. Ballard: Metallisation with special reference to Zinc Coatings to prevent Corrosion of Structural Steelwork.

INSTITUTION OF MECHANICAL ENGINEERS (Leeds Branch) (Annual Meeting).—Prof. F. C. Lea: Repetition Stresses.

*SATURDAY*, JANUARY 16.

SCOTTISH JUNIOR GAS ASSOCIATION (at Royal Technical College, Glasgow), at 7.—D. Garrie: Paper.

### PUBLIC LECTURES.

*MONDAY*, JANUARY 11.

DYERS' HALL (Dowgate Hill), at 6.—C. M. Whittaker: Artificial Silk Dyeing.

*FRIDAY*, JANUARY 15.

UNIVERSITY COLLEGE, at 5.—Prof. T. Borenius: Donatello.