



SATURDAY, OCTOBER 21, 1933

No. 3338

Vol. 132

CONTENTS

	PAGE
Scientific Management	617
Philosophy and the Astronomers. By R. A. S.	619
Mr. Wells Comes Back. By L. H.	620
Mosses and Hepatics. By C. V. B. M.	622
Short Reviews	623
Natural Colouring Matters and their Analogues. By Prof. Robert Robinson, F.R.S.	625
Protection Against Yellow Fever	628
Solomon's House. By T. Ll. H.	629
Obituary :	
Major C. K. Cochran-Patrick, D.S.O., M.C.	630
Prof. R. Ramsay Wright. By J. P. McM.	631
News and Views	631
Letters to the Editor :	
Absorption of Cosmical Radiation.—Prof. Frederick Soddy, F.R.S.; Harris Booth	638
Atomic Transmutation and the Temperatures of Stars.—Sir Arthur Eddington, F.R.S.	639
Ionic Exchange and Sorption of Gases by Chabazite.—Dr. E. Rabinowitsch and W. C. Wood	640
Tunny in the North Sea.—Dr. H. C. Delsman	640
Sex Behaviour of Hypophysectomised Male Rats.—Dr. B. P. Wiesner and Miss N. M. Sheard	641
Investigations on Aquatic Fungi.—W. R. Ivi- mey-Cook and E. J. Forbes	641
Diagnosis of a Nervous Disease by Sound Tracks.—Miss F. Janvrin	642
Biological Effects of Abnormal Weather.—Prof. Julian S. Huxley	642
Selenium Dehydrogenation of Sitosterol.—Prof. L. Ruzicka, M. W. Goldberg, G. Thomann and E. Brandenberger	643
Addition of Hydrogen Bromide to Olefinic Acids. —Dr. R. P. Linstead and H. N. Rydon	643
The "Leeds Portrait" of Joseph Priestley.—Dr. Douglas McKie and W. Cameron Walker	643
Research Items	644
Progress in Aeronautics Research	646
Applications of Statistical Methods. By Prof. H. T. H. Piaggio	647
Origin of the Celts	648
The 'Iconoscope' for Television	648
University and Educational Intelligence	649
Calendar of Nature Topics	650
Societies and Academies	651
Forthcoming Events	652
Official Publications Received	652

Scientific Management

AT the recent Leicester meeting of the British Association, Major L. Urwick, Director of the International Management Institute, contributed an important paper on "Organisation as a Technical Problem" to the proceedings of the Department of Industrial Co-operation of Section F (Economic Science and Statistics). The general thesis of the paper was that there are principles of organisation which can be arrived at inductively from the study of human experience and that these should govern arrangements for human association of any kind. Major Urwick argued that these principles can be studied as a technical question, irrespective of the purpose of the enterprise, the personnel composing it, or any constitutional, political or social theory underlying its creation. They are concerned with the method of subdividing and allocating to individuals all the various activities, duties and responsibilities essential to the purpose contemplated, the correlation of these activities and the continuous control of the work of individuals so as to secure the most economical and the most effective realisation of the purpose.

In existing world conditions, the practical importance of this subject can scarcely be exaggerated. In every aspect of its common life, humanity is registering failures, and enormously costly failures, in its capacity for purposeful association. The majority of all nations earnestly desires peace; the machinery of peace works haltingly and ineffectively. In country after country, liberty of speech and of person is lost, because democratic institutions fail to devise an administrative structure adapted to the speed and complexity of social evolution. The world's productive equipment is manifestly capable of yielding vastly increased quantities of goods and services. A machine technology points to the obvious economies of large-scale units of business control; amalgamations founder because there is widespread ignorance as to the methods of managing these aggregations.

Emphasising the importance of co-ordination as a principle of organisation, Major Urwick pointed out that co-ordination operates in two different senses. The work of individuals is always divided horizontally into different tasks. Such subdivision is usually either 'serial', where the responsibilities follow each other in process, or 'unitary', where the responsibilities are defined by areas or objects; or 'functional', where the responsibilities

Editorial and Publishing Offices :

MACMILLAN & CO., LTD.

ST. MARTIN'S STREET, LONDON, W.C.2

Telephone Number : WHITEHALL 8831

Telegraphic Address : PHUSIS, LESQUARE, LONDON

Advertisements should be addressed to

T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4

Telephone Number : City 4211

are distinguished by kinds or subjects. But where any large numbers are concerned, work must also be divided up perpendicularly into different levels of authority and responsibility. The adjustment of the resulting authorities and responsibilities to each other, and their continuous correlation, constitute one of the main tasks of leadership in any enterprise.

The evolution of ideas on this question has been comparatively simple. Originally almost all undertakings were organised on what has been called the 'line', or incorrectly the 'military', principle. The considerations which appeared of greatest importance were that there should be clear lines of authority running from the top into every corner of the organisation and that the responsibility of subordinates exercising delegated authority should be precisely defined. Since in all cases concrete objects, physical boundaries, or the limits of some well-known technical process, offer the simplest and readiest means of definition, the unitary or serial methods were almost universally adopted in dividing responsibilities horizontally.

Modifications of this arrangement have occurred throughout the history of human organisation. Wherever human knowledge and skill have been specialised—for example, in the case of the law—somehow and somewhere that specialised authority has had to be integrated with overall authority and responsibility. But since the introduction of power-driven machinery and the great advance in applied scientific knowledge of the nineteenth century, the amount and complexity of specialised skill required in connexion with every kind of human enterprise has vastly increased. The first formal recognition of the consequence of this tendency came from F. W. Taylor. Imbued as he was with the necessity of basing industrial management upon exact measurement and specialised knowledge, he was impressed with the impossibility of discovering subordinates who could exercise overall responsibility with maximum efficiency in respect of all its aspects. He substituted for it two of his well-known principles of management. The first was the separation of planning from performance. The second was the substitution for the older type of organisation of what he called 'functional' management. But when the conception of a horizontal division of responsibilities by function is carried high up the line of control in any large enterprise, difficulties are encountered in securing co-ordination. The solu-

tion so far adopted in practice is known as the 'staff and line' system of organisation. In business concerns which have paid close attention to organisation, the relationships between 'staff' and 'line' officials have been defined clearly, and indeed hitherto the major emphasis in business organisation has been placed on this question of relationships.

The degree to which 'staff' are allowed to assist their chief is largely an individual question, depending on the chief's powers of delegation. The functions of administration as analysed by Henri Fayol show that, in every case, staff, if properly used, can assume responsibility for the whole or a proportion of each aspect of these functions; the hard core of responsibility, the final decision, remaining of course with the chief.

The consequences of the lack of co-ordinating mechanism in civil life may be noted. First is the proliferation of committees which is so characteristic of organisations of all kinds. A committee is a device for correlating different points of view. But it is an extremely expensive device. It is sometimes forgotten that the cost of any committee is the combined salaries of its members for the time spent at the committee or preparing for it. Possibly the popular saying that 'the best kind of committee is a committee of one' is a subconscious recognition of the fact that many committees have only come into existence because an individual vested with the authority and possessing the capacity to do that particular kind of work has not been appointed. A second and even more serious consequence is the petrification of leadership which follows from an overloading of administrative work.

Civil administrators have found it difficult to understand the special relationship by which an army commander retains his full responsibility while delegating much of the work of administration. Failure to appreciate the proper functions of officials in a 'staff' capacity or to recognise the necessity for this third type of function, distinct both from 'line' and from 'specialised' authority, is the chief obstacle to more effective co-ordination in civil administration. Rapid growth in scientific knowledge has placed an unprecedented strain on man's powers of organisation. The effects of that strain are just becoming apparent; to meet it, increased knowledge of, and interest in, the technique of organisation and in its basic principle of co-ordination are urgently needed.

Philosophy and the Astronomers

God and the Astronomers: containing the Warburton Lectures 1931-1933. By the Very Rev. Dean Inge. Pp. xiii+308. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 12s. 6d. net.

THE astronomers are, mainly, Eddington and Jeans. Eminent though these names are, some may demur that they do not stand for any generally accepted doctrine; nor indeed represent the whole body of astronomers dispersed throughout the world; nor have they always agreed with one another in important matters. We read on p. 58 that "the utterances of our leading scientists are enough to drive a poor layman to despair". One can sympathise; they might indeed. Especially if a writer, however learned and acute, were to try to make a coherent statement of what is now agreed in physics, by the longest of short cuts, namely, without really esteeming what science has to say.

That is the summary of this book. Dean Inge is both learned and acute, and has taken great pains to acquaint himself with the written words. They are foreign to him, as in an earlier day they were foreign to Lucretius. A great deal of good astronomy was done before the time of Lucretius, and he took the pains to read it, and has given, for example, the geometrical explanation of the phases of the moon that is now accepted, with a brevity and point that astronomers can only envy; but it meant nothing to him, and he prefers the crude doctrine of a new moon created each month, growing and dying away. So one can foresee the failure of Dean Inge to get the right hang of "the expanding universe". The things he is intensely interested in are philosophy, and ethics, and the Christian religion. Science looms across these. The whole world knows that science has forced it to replace a geocentric order by a universal one, with immense consequences in difference of perspective. The law of the degradation of energy, somewhat belatedly, plays a similar part. We have reason to think that something more, even more momentous, is in view. An intelligent man ought to know something about it, so, what in fact do the astronomers say? No one is very eager to answer. One may smile at being thus asked to stand and deliver.

But however well scientific men may know their own job, and however little they may reckon the consequences to others of what they say, we

are not disposed to leave the book thus. When called upon by a man of Dean Inge's authority to explain themselves, they must reply. It signifies something to them that the whole world now looks to them for guidance. It behoves them, as honest men, either to justify the responsibility or to disclaim it. To an intensely serious mind, interested primarily in human fate, and persuaded that there is open to each of us an avenue to the Divine, some of the hypotheses of science, with the contradictions to which they lead, with their absence of 'value' in the philosophical sense, as well as mere human love of a joke or a contradiction as such, may convey a certain levity. All rests in the manner of approach. One of the most tremendous problems before the moralist is that of the origin of evil. To the scientific worker it scarcely seems a problem at all. If Nature maintains a balance by conflict, as she appears to do, and if man has developed unequally, it is to be expected that his powers should be used for selfish and unwise ends. One must not expect the moralist to agree. In another connexion, Dean Inge quotes the word of Lotze—"intolerable"—which is so strange a consideration to us that the word stands out. One might aptly describe this cold-blooded solution as intolerable.

Every statement comes from a human mind, and must be qualified by one's estimation of whether that mind knows what it states. In this view, however many people unite in a statement, and however nearly, therefore, it may be taken as agreed, it will never get rid of the limitations of the human mind. It may be that the mind has no limitations, but this seems unlikely, and until it is demonstrated, it must be taken as a hypothesis. There is then no guarantee at all that realities are anything like what science pictures them. To some, this saps all energy in the search as to their nature. Science demonstrably 'works'; therefore it has *some* relation to reality; but does it lead, even by the stumbling method of advance that it has found for itself, to any approximation to a picture of things as they are? For example, in what respect do they progress in time? It would be a rash man of science who gave a positive answer.

The modern philosopher weighs the world by 'values'. Though many people seem to agree as to values, values are essentially personal, and science is impersonal. Science, therefore, has no use for values, and moves in a world where values do not vary, which is the same thing as if they did not exist. To avoid them, it must restrict

its scope. Science knows nothing at all of what matters most to us—God, human destiny, ethics, and other things. Even society becomes an eviscerated society before science can deal with it. Philosophy, on the other hand, repudiates limitations. The contrast may be seen in the title of Descartes' great work—"Philosophiæ Principia"—with that of Newton—"Philosophiæ Naturalis Principia Mathematica". The restriction is a gain. In consequence of this limitation of its objects, science has been successful, whereas philosophy is confessedly unsuccessful. As Dean Inge says, we have ceased to look to a philosopher for more than remarks upon the great problems, whereas we used to look for a complete system.

Possibly science has been too successful, causing many people to forget its self-imposed limitations, and others to expect too much from it. The day has gone by when, as someone said, metaphysics might be likened to "a man searching in a dark room for a black hat that wasn't there". It is only when religion travels out of its proper sphere, and attempts a statement that is really of the nature of pseudo-science, that it risks coming across the views of scientific men as such. It would be impossible now to persuade them that the earth was the centre of the universe, or that energy here did not degrade to an ultimately useless form. The demonstrations need not be logically water-tight. Gilbert showed that the earth was a magnet by constructing a little earth, a *terrella* of lodestone, and no one since has doubted the fact. There are enormous logical gaps before Newton's Law of Gravitation can be taken as universal; the conviction stands nevertheless. But any scientific worker, or anyone else, may believe that there is an "enduring Power, not ourselves, which makes for righteousness". Science has nothing to say about it. It does not know what righteousness is.

One meets in this book, and elsewhere, inevitably, a great deal of talk about the scope of mathematics. One characteristic of the mind is that it is conscious of the present, and to some extent of the past, but not in the least of the future. Why has it memory and no prescience? Does the past exist and not the future? It would be very convenient if we knew the future even roughly. To have some guide to what will happen, the mind has invented the tool of logic, which works passably well. If *B* followed *A* in the past, then *B* will follow *A* in the future. This exposes the assumption on which logic rests, for we know

nothing about the future. Mathematics is only a specialised form of logic. The assumption here takes the form that time is reversible. Mostly it is evidently not reversible. The old geometry avoided the dilemma by 'eliminating' time from its purview. Anyhow, when we deal with time by mathematics, evidently we are in for contradictions. Dean Inge devotes a whole chapter to time. When we have read it, we are much better informed on what others and himself say about it, but the matter is not advanced in the scientific sense. The same is true of the whole book. It is a learned book and contains a great many statements of sincere beliefs, but science is no wiser for them.

R. A. S.

Mr. Wells Comes Back

The Shape of Things to Come: the Ultimate Revolution.

By H. G. Wells. Pp. 432. (London: Hutchinson and Co. (Publishers), Ltd., 1933.) 10s. 6d. net.

FEW realise that there is no longer any biological reason why a man should cease to be creative before he is eighty. Those of us who admired the earlier Wells could watch with resignation the steep descent from the wistful and sanctimonious penitence of Mr. Britling to the hearty and eupeptic prosperity of William Clissold. We were accustomed to the phenomena of senescence and had not yet taken stock of the possibilities of rejuvenation. The cremation of Clissold was scarcely completed before the whimsicality of Dr. Moreau was reborn in the person of Mr. Bletsworthy. Then followed the incarnation of Mr. Parham with a polished irony lacking in the earlier romances. As literature, the dream book of Dr. Raven surpasses anything which Mr. Wells has written. It engenders the impulse to read aloud and to go on reading. Its pages have been composed with a tragic distinction of language only to be found among contemporary writings in some passages of Bertrand Russell's "Principles of Social Reconstruction", in Briffault's "Making of Humanity" or in the final saga of the men on Neptune in Olaf Stapleton's "First and Last Men". It has the passionate and intoxicating earnestness of the "Dictionnaire". It is pervaded by a kindness which was lacking in Voltaire, a kindness which never degenerates into the obese complacency so repugnant in the middle period of the author's work. It is more than a history. It is an historic testament.

The writer of the dream book is living in a communist Utopia. Those worthy and sententious

scoutmasters and storm troop leaders, the Samurai of a younger Wells, have withered away. At a safe distance of two centuries from the conflicts of our own time, he can afford to criticise the shortcomings of Marx or the Soviet policies like a liberal historian of the early twentieth century pronouncing judgment on John Knox or the Kingdom of God in Münster. Naturally his strictures will irritate those who insist on adopting the historical approach to everything but their own actions. Still more will they infuriate the self-satisfied and socially indifferent. We see the Pompeian streets of contemporary civilisation spread beneath the shadow of a menacing Vesuvius. In the cold corridors of the museum, our mummified remains are caught in the act of gesticulation or in the affectation of negligence. Those of us who have an all too simple plan for propitiating the seismic fury which is about to break upon us, and those of us who proudly boast a refined indifference to the properties of incandescent lava, seem a little ridiculous to the serene onlooker. Few intelligent people will read the history without annoyance. No intelligent person will find it a dull book.

Throughout the first half the reader is carried along by the circumstantial inevitability of the events. The great halt to social progress in 1933 has already become history. That the bulk of educated mankind in Western Europe will acquiesce or participate in the recrudescence of barbarism, and march back towards the neolithic behind the swastika emblem, seems scarcely less certain than if the tale had already reached its disastrous climax in the epidemics which follow in the trail of the European War of 1940. There are oases of deliberate comic relief. Such is the incident which precipitates the call to arms, the ill-fitting dental plate, the orange pip or, it may be, a small fragment of walnut. The prelude to the emergence of the World State is a monument of moving prose. For six pages (pp. 275-281) of sustained and pregnant rhetoric which may be remembered with the "Areopagitica", Wells pleads the defence of that troublesome but vital part of the machinery of social change, the crank.

Thereafter the recital lacks the cogency of detail in the earlier part. Maybe this is the author's intention. Among the ruins of Europe there are few records for the historian to use. Communication comes to a standstill and mechanical production almost ceases. Locally a few aeroplanes and aeroplane factories are salvaged, and these form

the only apparatus of trade exchange. The workers and technicians of the Transport Union are not hide-bound to the old loyalties. From their aerial Hanseatic League a world government takes shape in 1965. The dream book *Russia*, somewhat hampered in its further cultural development by a conservative adherence to rigid dogmas which had served well enough in the pioneer stage of the planned economy, is readily assimilated in a wider and more cosmopolitan project. Elsewhere the competitiveness of the Acquisitive Society is morally and materially bankrupt. There are local rebellions and obstructions. They are half-hearted and ill-equipped against a civilisation which controls all backward and forward movements of people and produce.

In spite of the inveterate dislike which Mr. Wells displays towards Karl Marx, and the equally strong antipathy which such speculations will evoke from present-day disciples of Marx, his forecast has a plausibility which is eminently reminiscent of the author of the "Eighteenth Brumaire". Not until the introduction of steam power did the struggling Protestant democracies of the sixteenth and seventeenth centuries become the pattern of a well-nigh universal type of government and economy. The imaginative drive of the recital is such that one may well expect the political critics of Mr. Wells to blame him for inventing a future which need not happen, if they heed his warning. It is a memorable warning, the more memorable because, like the familiar warning of the elder Pitt, it may be destined to fall on deaf ears.

In the final chapters Wells justifies his claim to be regarded as the midwife of social biology. He steers a rational course between the naïve environmentalism of some Marxists and the paralysing calvanism of most eugenists. He does not picture the historic environment moulding to its pattern a species from which all gene differences have been mysteriously obliterated. He does not conjure up a mosaic of gene combinations miraculously regulating the developmental process in a perfect vacuum. He sees the procession of human beings of diverse capacities and various endowments making their several contributions to the future and interacting with one another within the limits set by a social framework prescribed by the efforts of past generations and constantly being changed by human activities. Because the limits are constantly shifting, because man is at once a highly variable organism and the most teachable of animals, education is the supreme business

which may fittingly engage the services of the most gifted men and women. It is a process which could be extended from birth until death. Mr. Wells gives an object lesson of this more spacious conception of our capacity for continued growth. As an artist and as a leader of thought he has come back at sixty-seven to a world in which the Youth Movements are clamouring for reaction while his contemporaries are committed to inaction. L. H.

Mosses and Hepatics

Manual of Bryology. Edited by Fr. Verdoorn, in collaboration with Dr. H. Buch, Dr. G. Chalaud, H. N. Dixon, H. H. DuBuy, M. A. Donk, Dr. H. Gams, Dr. A. J. M. Garjeanne, Prof. Dr. Th. Herzog, Dr. K. Hoefler, Dr. J. Motte, Prof. Dr. L. M. J. G. Nicolas, P. W. Richards, Prof. Dr. F. von Wettstein, Dr. R. van der Wijk and Prof. Dr. W. Zimmermann. Pp. ix+486. (The Hague: Martinus Nijhoff, 1932.) 20 guilders.

IN the production of this book Dr. Verdoorn, who is a well-known hepaticologist, has enlisted the collaboration of distinguished bryologists who have specialised in different aspects of the science. This subject is yearly attracting increasing interest and hitherto no comprehensive work of this kind has been attempted. The international nature of the "Manual" is emphasised by seven chapters being written in German, six in English and three in French, though readers in Great Britain and in the United States might wish more had been written in the language of the title.

Chap. xv, dealing with the classification of hepatics, is from the pen of Dr. Verdoorn himself. As he says, hepaticological literature, particularly in respect of exotic floras, is in a chaotic condition. "Critical revision of most genera is now, above all things not only desirable but also necessary." The corresponding chapter (xiv) on the classification of mosses is written by Mr. H. N. Dixon, who has long been the best-known systematist in Great Britain on this group. His task has been a more difficult one, since there is much less agreement on the criteria for the major classification of mosses than of liverworts. Other subjects, each receiving a chapter to themselves, are: morphology and anatomy of the mosses and hepatics, by R. van der Wijk and H. Buch respectively; experimental morphology, by H. Buch; germination of the spores and the protonema stage, by G. Chalaud; association of bryophytes with other organisms, by G. Nicolas; cytology, by J. Motte;

karyology, by K. Hoefler; physiology, by A. J. M. Garjeanne; genetics, by F. von Wettstein; geography, by Th. Herzog; Quaternary distribution and bryo-cenology (moss societies), both by H. Gams; ecology, by P. W. Richards; and phylogeny, by W. Zimmermann. The names of two other collaborators appear on the title page, but do not figure in the contents.

While enjoying the great advantage of contributions by specialists, this symposial method naturally suffers somewhat from lack of uniformity of presentation, and a detailed critical review of this work would necessarily consist of a large number of separate reviews of the portions contributed by each of the several authors. It is explained in the preface that the decisive factor which has been principally kept in mind as to whether or not much literature is cited, is whether any recent work with this information was easily available to the reader.

A whole chapter in French is devoted to the germination of the spores and the protonema stage, in which Dr. Chalaud contrasts in a particularly lucid manner the protonemal development of the mosses and hepatics.

Dr. Gams gives a concise account of our knowledge of the distribution of the Bryophyta in Quaternary times. He makes an important correction of an error in the "Fossilium Catalogus", vol. 2, 13 (1927), but it would appear evident that where he uses the word mosses on p. 301, l. 5, he intends bryophytes (that is, mosses and hepatics together). During the Pliocene, the bryophyte flora of the northern hemisphere was very much like the present one, but probably owing to the unequal capacity for preservation, only 2.8 per cent of the 1,400 species known from the whole Quaternary period are Hepaticæ. The author emphasises the incompleteness of the fossil record, which never indicates the whole flora of any territory, while we have no fossils at all of true prairie or steppe mosses.

It is perhaps inevitable that a few typographical errors (mostly of little importance) should have crept into a book produced in three languages, none of which is that of the country of the publishers, but the typography is pleasing and it is well illustrated by line drawings and distribution maps as well as by photographic reproductions, altogether some 129, while there are full indexes to plant names and authors. Bryologists throughout the world will welcome the publication of this work.

C. V. B. M.

Short Reviews

Our Changing World-View: Ten Lectures on Recent Movements of Thought in Science, Economics, Education, Literature and Philosophy. By Lieut.-Gen. the Rt. Hon. J. C. Smuts, Dr. Robert Broom, Prof. J. P. Dalton, Prof. John F. V. Phillips, Prof. J. Y. T. Greig, Prof. T. J. Haarhoff, Prof. C. S. Richards, Prof. S. H. Frankel, Prof. R. F. A. Hoernlé, I. D. MacCroné. Pp. vi+172. (Johannesburg: University of the Witwatersrand Press, 1932.) 10s. 6d.; single lectures 1s. 6d. each.

THE ten lectures contained in this volume were delivered under the auspices of the University Philosophical Society during June–September 1932 in aid of the Library Appeal Fund of the University of Witwatersrand. The lecturers include General J. C. Smuts, who discussed “Recent Advances in Science and Philosophy”; Dr. Robert Broom on “Evolution—Accident or Design”; Prof. C. S. Richards on “Our Changing Economic World” and Prof. R. F. Alfred Hoernlé on “Old Truths and New Discoveries”. Prof. J. Y. T. Greig’s lecture on “Literature in the Machine Age” emphasises the dangers which attend the scientific habit of considering things in isolation when applied to our intricate civilisation, and he vigorously opposes Prof. J. F. V. Phillips’s plea for a wider use of the scientific expert in government. Prof. Phillips’s lecture on “Man at the Cross-Roads” betrays the same consciousness, however, of the distinction between knowledge and wisdom, and both lectures, like those of Prof. T. J. Haarhoff on “The Holistic Attitude in Education” and Prof. S. H. Frankel on “Africa in the Re-Making” are permeated with a desire to make some effective contribution to the solution of African problems.

The frank facing of realities in the South African situation in these lectures should give them an interest beyond South Africa itself and their pragmatism as much as the holistic outlook give unity to the series. Beyond this they indicate the high conception of educational work which the University of Witwatersrand cherishes, and represent an attempt to encourage the spread of a wider culture among the people of South Africa as a whole.

Animals, Consider Your Verdict! (Vol. 2 of the Animal Year Book.) Pp. 147+xv+7 plates. (London: University of London Animal Welfare Society, 1933.) 2s. 6d.

UNDER this not very happily conceived title the University of London Animal Welfare Society has brought together a very instructive and useful summary of what is being done in the suppression of cruelty to animals, the world over. Yet one cannot but feel that there is a grave danger of concentrating on themes like the slaughter of animals, where the pain inflicted has most certainly been exaggerated, and losing sight of many

grave aspects of cruelty to animals where education and reform is long overdue. These include the sufferings of animals trapped for fur; and the use of poisons for so-called ‘vermin’, bringing painful death to thousands of animals against which no charge is made.

On the other hand, we still have fanatics to curb. In this volume a hope is solemnly expressed that we should behave more kindly to fish taken in trawl-nets. In the course of time, it is suggested, they will be killed by a depth-charge before being brought to the surface! Will the distinguished sponsor to this proposal tell us how the force of the explosion is to be confined to the fish *inside* the net. What of the wanton waste of life such crass stupidity would entail on the fish *outside* the net, and over a wide area?

It is surely time that attention was concentrated on the need of a more intensive study of the haunts and habits of the wild creatures of the British Isles, and especially in regard to their feeding habits. We are all too often asked to slay birds and beasts because of the damage they are supposed to cause to the farmer, or gardener, game-preserve or pisciculturist. The outcry against the seals in the Wash, where the aid of gun-boats was invoked, and of the tern colony at Blakeney, afford instances in point. Investigation showed that there was not the slightest foundation for these demands for extermination. We commend this field to the Animal Welfare Society.

A Star Atlas and Reference Book (Epoch 1920): for Students and Amateurs. By Arthur P. Norton. Fifth edition, Maps completely revised, with new I.A.U. Boundaries. Pp. viii+62+18 maps. (London and Edinburgh: Gall and Inglis, 1933.) 12s. 6d. net.

AMATEUR astronomers, all who possess private telescopes, and all those whose friends want to “see through a telescope” will welcome this work. As stated, the new edition contains the new boundaries of the constellations as recently adopted by the International Astronomical Union. Besides containing star charts, each of which is accompanied by a list of telescopic objects in the way of double stars, variable stars, nebulae and star clusters, this convenient volume contains 62 pages of reference matter which cover a surprising range of astronomy and astrophysics, including a page or two on spectroscopy and the atom. All the subjects are treated in the manner best suited to the immediate practical needs of a man who wants information in a hurry. While many amateurs will keep this reference book near their telescopes, we may hope that they will go on to read more extended accounts of the physical and astrophysical topics which are but lightly touched upon in the volume.

Life in Lesu: the Study of a Melanesian Society in New Ireland. By Dr. Hortense Powdermaker. Pp. 352+13 plates. (London: Williams and Norgate, Ltd., 1933.) 15s. net.

LESU is an island on the east coast of New Ireland, one of the islands of the Bismarck Archipelago, in which Dr. Powdermaker resided for ten and a half months for the purpose of anthropological investigation. The village belongs to one of the nine linguistic groups of the island, but its dialect had not previously been recorded. The inhabitants are the tall and usually well-built Melanesians typical of New Ireland.

Dr. Powdermaker was engaged more particularly in the study of the social anthropology of the village. It is evident that she has a gift of fraternisation with natives. She has brought back a wealth of detail on every phase of native life, much of it of a most intimate character which could have been obtained only on the terms of a close and confidential relationship with her informants. Her book, especially in its sense of proportion in estimating the relative importance of customs and social and religious regulations in daily life, is a valuable addition to the growing literature of the functional anthropologist.

Life-Histories of the Frogs of Okefinokee Swamp, Georgia. By Albert Hazen Wright. (North American Salientia (Anura), No. 2.) Pp. xv+497+45 plates. (New York: The Macmillan Co., 1932.) 8 dollars.

THIS fresh-water swamp, some 660 square miles in area, lies in the coastal plain of the south-eastern United States, and still retains in a large measure primitive conditions of environment, rapidly changing under the hands of the lumber-men. The volume forms part of a biological reconnaissance of the swamp and includes very full accounts of the systematic characters and of the habits and the life-histories of the eighteen species of *Salientia* which have been found there. Photographs illustrate the life-histories as well as the adult appearance. Unfortunately the absence of the author from the area during the autumn and winter months has precluded any observations or discussion about hibernation, but there is much information regarding the calls of the different species and the relationship of croaking to temperature and moisture.

See for Yourself: a Field-Book of Sight-Seeing. By Edmund Vale. Pp. xii+276. (London and Toronto: J. M. Dent and Sons, Ltd., 1933.) 5s. net.

THIS book is indeed archæology 'without tears'—a sightseer's handbook which deserves commendation not only for the originality of its conception, but also for the manner in which that conception has been carried out. The sightseer is conducted, a little breathlessly perhaps, through the whole range of British archæology, from earliest prehistoric times down to the eighteenth century

of our era, and persuasively instructed what to look for as the characteristic features in our ancient monuments. A chapter is devoted appropriately to the works of preservation undertaken by the Office of Works; and glossaries, a table of scripts, and a list of useful dates—the whole illustrated by line sketches and diagrams—complete an excellent and really helpful work of popularisation.

The Making of the State. By M. Ruthnaswamy. Pp. 503. (London: Williams and Norgate, Ltd., 1933.) 21s. net.

THIS textbook of political science is of special interest to English readers at the moment. The author, a lecturer in history and politics in the University of Madras, in bringing forward anthropological fact in support of his views on the origin and growth of society, has drawn freely on his knowledge of Indian institutions in the light of history and as they work in practice to-day. His views on caste will be found particularly interesting, especially as in noting relaxations in the regulations affecting the higher castes he does not draw the same inferences as to the weakening of caste as have been drawn by some recent writers. His views are the more convincing in that they are not intended to have a topical reference but are strictly incidental to the main purpose of his book.

The Foundations of the Universe. By A. L. Warham. Pp. 43. (London: The C. W. Daniel Co., 1933.) 1s. net.

IT is to be hoped that the reactions of this author to the many accounts that have appeared in the past decade of recent advances in astronomy and physics are not typical of the lay public in general. He quotes and abstracts sometimes from popular works, and sometimes from authorities: Einstein, O. W. Richardson, J. J. Thomson, Dirac, Sir Oliver Lodge and Dr. R. L. Waterfield appear successively on but six pages. The author interlards his quotations and abstracts with his own remarks, which cast doubt upon his ability to comprehend his sources. Where the author is correct he is commonplace, and where he is original, he is wrong.

The Conductivity of Solutions. By Dr. Cecil W. Davies. Second edition, revised and enlarged. Pp. x+281. (London: Chapman and Hall, Ltd., 1933.) 15s. net.

DR. DAVIES'S book, the first edition of which was reviewed in *NATURE* of September 20, 1930, p. 429, under the title "Strong and Weak Electrolytes", has been revised, and enlarged by about eighty pages, but without any corresponding increase in price. In addition to a general revision of the text, two new chapters have been added, dealing with conductivity titrations and other applications of conductivity measurements. The merits of the work are therefore fully maintained and the second edition is likely to be even more useful than the first.

Natural Colouring Matters and their Analogues*

By PROF. ROBERT ROBINSON, F.R.S.

THE chemist has been attracted to the investigation of natural and artificial colouring matters for a variety of reasons, including not only colour-pleasure, the incentive of the knowledge that chlorophyll and hæmoglobin perform some of the most important functions in vital processes, and the industrial importance of dye-stuffs and pigments, but also on account of the fact that visible colour more than any other property facilitates the experimental study of organic substances whether by analysis or synthesis. It furnishes a standard of homogeneity or a measure of concentration, it is an invaluable guide in the search for methods of separation and purification, and it at once indicates, by its appearance or disappearance, the occurrence of a chemical reaction. Small wonder that the successful outcome of the investigation of many colourless substances has awaited the discovery of some characteristic colour-reaction; a noteworthy example being vitamin A.

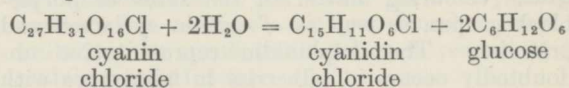
A catalogue of outstanding achievements in this field invites destructive criticism. I do not fear this, however, in recalling the researches of Laurent, Kekulé, Baeyer and Heumann on indigo; of Sir William Perkin, Hofmann, Otto and Emil Fischer, Meldola and many others on the basic dyes; of Griess and his host of followers on the azo-compounds; of Arthur Perkin and of Kostanecki on the flavones and flavonols; of Willstätter on the respiratory pigments and the anthocyanins; and, not least, of Hans Fischer on the synthesis of the prosthetic group of the blood pigment.

No attempt can be made to cover this vast field, but the mere mention of these topics serves to prove the immense theoretical and practical value of a study of organic colouring matters. The work proceeds, and a long chapter of great chemical and biological interest on the natural carotinoid pigments is even now being written by Karrer, Kuhn and others.

OCCURRENCE OF ANTHOCYANINS AND THEIR DERIVATIVES

The brilliant and pioneering researches of Richard Willstätter and his co-workers since 1914 have established the main features of the chemistry of the anthocyanins, which were recognised as saccharides, occasionally acylated, of the cyanidinins. They exhibit amphoteric character, forming salts with both acids and bases. Thus the violet pigment cyanin, which can be isolated from blue cornflowers, red roses, deep red dahlias and other flowers, forms a blue sodium salt and a red hydrochloride. The hydrolysis of the latter by means of hot aqueous hydrochloric acid into

cyanidin chloride and glucose is represented by the equation:



The constitution of cyanidin chloride has been established by analysis and numerous syntheses; the first of these (Willstätter and Mallison) utilised the reduction of quercetin by means of magnesium in aqueous methyl alcoholic hydrochloric acid solution.

In this process a widely distributed anthoxanthin yields a widely distributed anthocyanidin, and the temptation to assume that similar reactions occur in the plant laboratory is very great. There is, however, very little justification for this view, and the experimental support brought forward in its favour will not survive careful scrutiny. The alleged crystalline anthocyanins prepared by the reduction of natural flavones or plant extracts containing them are nothing but the said flavones with a small proportion of adsorbed colouring matter of anthocyanidin type. It seems much more probable that the flavones and anthocyanins are independently synthesised, although perhaps from a common starting point. The existence of genetic factors which control the occurrence of anthoxanthins independent of that of anthocyanins is strong evidence in favour of this view.

The anthocyanidins which have been isolated are pelargonidin, cyanidin, peonidin, delphinidin, petunidin, malvidin and hirsutidin, represented as chlorides. All have been synthesised by unambiguous methods and the synthetic specimens have been carefully compared and identified with the natural products. Pelargonidin, cyanidin and delphinidin are the fundamental types, peonidin being a methyl ether of cyanidin and petunidin, malvidin and hirsutidin being, respectively, the mono-, di- and trimethyl ethers of delphinidin.

The greater number of the anthocyanins fall into a comparatively restricted number of categories, including: (a) the 3-monoglycosides and 3-mono-galactosides, (b) the 3-rhamnoglycosides and other 3-pentoseglycosides, (c) the 3-biosides, (d) the 3:5-diglycosides, and (e) the acylated anthocyanins. It is unnecessary to recount the steps taken in reaching these conclusions, but they have been finally justified by synthesis in many instances.

In group (a) we find callistephin, the monoglycoside of pelargonidin occurring as one of the pigments of the aster and as the main pigment of scarlet carnations and many other flowers; the related galactoside, fragarin, is the colouring matter of the strawberry.

In the cyanidin series the corresponding pair is chrysanthemine and idæin, the former of wide

* From the presidential address before Section B (Chemistry) of the British Association, delivered at Leicester on September 7.

distribution and the latter occurring in the skins of cranberries and in the leaves of the copper beech.

Peonidin 3-monoglycoside, termed oxycocyanin, is found in the skins of the larger American cranberries and cœnin or malvidin 3-monoglycoside is the colouring matter of the skins of purple-black grapes, as well as of certain cyclamen and primulae. The delphinidin representative undoubtedly occurs in bilberries in admixture with other pigments, and it has not yet been fully examined; the petunidin and hirsutidin representatives have not been isolated from natural sources, although there is reason to believe that the former occurs in the berries of the Darwin barberry and the latter has been synthesised.

In groups (b) and (c) we find large classes of anthocyanins of which only a few representatives have been closely studied. These include keracyanin (cyanidin 3-rhamnoglycoside), probably identical with antirrhinin (isolated by Miss R. Scott-Moncrieff), and meococyanin, a pigment of red poppies which is now recognised by synthesis as cyanidin 3-gentiobioside. There is very little doubt that pelargonidin 3-rhamnoglycoside colours the scarlet gloxinia and that pelargonidin 3-biosides are of widespread occurrence, for example, in the ordinary orange-red nasturtium and in the flowers of the scarlet runner bean.

The anthocyanins of groups (a), (b) and (c), when derived from the same anthocyanidin, exhibit similar behaviour as indicators. Thus chrysanthem, keracyanin and meococyanin all give a violet solution in aqueous soda and this becomes blue on the addition of caustic alkali. On partial hydrolysis, meococyanin and antirrhinin actually yield chrysanthem.

The anthocyanins of class (d) are the most widely distributed and best-known members of this series of natural pigments; they include pelargonin, the colouring matter of the scarlet pelargonium and possibly the first anthocyanin to be obtained in a crystalline condition (Molisch's experiment), also cyanin, the isolation of which from the blue cornflower by Willstätter and Everest in 1914 was the first of an impressive series of investigations.

Peonin from the deep red peony and malvin from the wild mallow or from certain primulas, are the peonidin and malvidin representatives in this group, which is completed by petunin and hirsutin. Quite recently the delphinidin member has been isolated from *Salvia patens*.

The anthocyanins of group (d) differ from those of groups (a), (b) and (c) in their alkali colour reactions and in their marked instability to aqueous sodium hydroxide. Thus cyanin, which compares with meococyanin in group (c), gives a pure blue solution in aqueous soda and the dilute solution becomes very quickly yellow on the addition of sodium hydroxide.

Pelargonin, cyanin, peonin, malvin and hirsutin have all been synthesised.

The anthocyanins can be characterised and

qualitatively distinguished by their distribution between immiscible solvents, and in the case of disaccharides the use of *n*-butyl alcohol is convenient.

Acylated anthocyanins occur in all the anthocyanidin series; thus, on hydrolysis, delphinin, the pigment of species of delphinium, furnishes *p*-hydroxybenzoic acid as well as glucose and delphinidin.

Many other delphinidin derivatives are acylated by means of *p*-hydroxycinnamic acid, probably attached to the sugar hydroxyls, and pelargonin and cyanin also occur in acylated forms. These so-called complex anthocyanins are characterised by high distribution numbers; they are usually acylated 3:5-dimonosides, but in the delphinidin series, gentianin and violanin appear to be *p*-hydroxycinnamates of delphinidin monoglycoside and rhamnoglycoside respectively (Karrer). There is also some evidence of another type of depside anthocyanin in which the acyl group is directly attached to the anthocyanidin molecule and the glycoside group is borne by the hydroxyl of the acid residue.

ANTHOCYANINS AS INDICATORS AND THE COLOURS OF FLOWERS

(WITH MRS. G. M. ROBINSON)

The amphoteric character of the anthocyanins accounts for the exhibition of a wide variety of colours in a range of solutions of graded hydrogen ion concentration, and this method, using buffered solutions, can be employed for the characterisation of anthocyanidins and anthocyanins. Under the specified conditions the results are fully reproducible and the hydrogen ion concentration values have been controlled by electrical methods as well as by the use of indicators. Thus, if the *pH* of an acid cyanin solution is increased until the violet tone matches that of an alkaline cyanin solution, the *pH* of which is decreased in order to reach the same condition, then the *pH* of the violet solution will be found to be 7.0-9.0, depending on the shade of violet produced. Cyanin is red in solutions of *pH* 3.0 or less, violet at *pH* 8.5 and blue at *pH* 11.0. The red, violet and blue forms are the oxonium salt, the colour-base and the salt of the colour-base.

Now cyanin was isolated by Willstätter and his colleagues from the blue cornflower and from the red rose, and it seemed quite a simple step to assume that the cell-sap in the cornflower was alkaline and that in the rose acid, particularly in view of the fact that the absorption spectra of the coloured aqueous extracts correspond with these conditions.

It has indeed been generally assumed that the indicator colour of the anthocyanin will give a measure of the hydrogen ion concentration of the cell-sap, but unfortunately this method cannot be relied upon for several reasons. In the first place there is a glaring anomaly in the fact that direct measurement by electrical methods (glass

electrode as arranged by Mrs. Kerridge) shows that the cell-saps are all well on the acid side of the neutral point. Thus the conventional view for red flowers may well be correct, but some special circumstances must be invoked in the case of blue flowers.

Turning at once to the blue cornflower (the cultivated annual kind), a blue filtered extract made with distilled water was found to be sufficiently acid to turn blue litmus red. Using 3 gm. of petals in 14 c.c. of distilled water (pH 6.3 owing to dissolved carbon dioxide), the pH was 4.9. (These quantities were used throughout the experiments and the use of larger relative quantities of the petals did not alter the hydrogen ion concentration appreciably.) Addition of a buffered solution of pH 4.4 did not affect the colour, but the colour changed to violet when the B.D.H. Universal Buffer, pH 9.0, was added. It was at once apparent that the only simple explanation is that the cyanin anion is present in a complex form, giving a stable aggregate with a negative charge; in some way the strength of cyanin colour-base as an acid must be vastly increased.

Some form of colloidal solution was considered most likely to fulfil the necessary conditions, and Dr. Conmar Robinson, of the Chemistry Department, University College, London, kindly examined a filtered, distilled water extract of blue cornflowers and reported as follows:

"The solution contains ultramicros easily visible in the slit ultramicroscope, but small enough to be in fairly rapid Brownian movement. Microcataphoresis showed them to be negatively charged. Without more quantitative work it is impossible to say if these particles can represent the bulk of the material present, but this seems probable if the solution is very dilute; the possibility of observing a colloidal impurity is always a trap. The visibility of the ultramicros suggests a lyophobic colloid. It is, however, not precipitated even by 2*N* NaCl, which indicates that a protective colloid is also present."

Our next step was to attempt the production of blue cyanin sols stable in neutral or weakly acid solution, and some measure of success was achieved, although the solutions are by no means so stable as those from the blue cornflower.

If a little crystalline cyanin chloride is added to boiling tap-water (pH 8.0) then the usual violet solution results (see above), the colour being what we consider 'normal'. If, however, the cyanin is triturated in the cold for a minute with the water and gradually heated to boiling with shaking, then a beautiful blue solution results. The fact that the same materials can be used to produce two entirely different results shows that it can only be the state of aggregation of the cyanin which can have stabilised the anionic charge and hence produced a blue colour under the conditions that normally produce a violet solution. If very small quantities of cyanin chloride are employed, this phenomenon can be reproduced using distilled water. Willstätter and

Everest found that their cornflower extracts contained xylan and other polysaccharides, and we have attempted to produce blue acid cyanin solutions in the presence of various polysaccharides. The addition of dispersed xylan and various kinds of starch, also agar-agar, makes the preparation of blue solutions of pH about 7.5 a very simple matter, but we have not yet found a way of imitating the cornflower solution in respect to its stability at pH 5.0.

Probably these colloid associations are much more readily formed at values of pH between 5.5 and 6.5, and on the whole the blue flowers have less acid cell-saps than the red flowers. The petals of the rose, in contrast with the cornflower, constitute an exception (pH 5.6).

It must be emphasised that variations of pH are quite insufficient in themselves to account for the colour changes and it is evident that the most important single factor for flower colour, given the nature of the anthocyanin, is the question of the condition of the pigment in solution, and it would appear that *all blue flowers are coloured by colloidal solutions of their respective pigments.*

Methods for the determination of the hydrogen ion concentration of the cell-sap of flowers depending on the use of the flower colours as indicators may be sound, but only if it can be guaranteed that the colloidal condition of the pigment solution is not altered by the extraction with the buffered solutions which are employed. In any event, the results bear no relation to the colours observed *in vitro* using isolated anthocyanins, and they cannot be transferred from flower to flower: the colour series depends almost as much on the other conditions in the cell-sap as on the hydrogen ion concentration and on the nature of the anthocyanin. Another aspect of pH of the cell-saps is that the higher values appear to be associated with the formation of delphinidin derivatives. The remarkable distribution in the tropæolum—Empress of India—is as follows: leaf, delphinidin diglycoside (pH 5.6); calyx, cyanidin 3-bioside (pH 5.0); flower, pelargonidin 3-bioside (pH 4.5). On the other hand, three scabious with anthocyanins based respectively on pelargonidin, cyanidin and delphinidin had all the same petal pH , 5.0.

We have already discussed elsewhere the influence of certain substances termed co-pigments on the colour of anthocyanin solutions; these effects are to be detected in strongly acid solution and the presence or absence of these substances is undoubtedly a factor to be taken into consideration. The extent to which the co-pigment effect is bound up with colloid phenomenon is a matter for future experiment and discussion, but it is convenient to maintain the term co-pigment for the present.

Dr. E. A. H. Roberts has observed the shift of the absorption bands of chrysanthemine and cenin chlorides on the addition of papaverine (strongly blueing effect) and narcotine (weak effect), and correlated this with a corresponding change

(lowering) of the distribution number of the anthocyanin using amyl alcohol.

It seems clear that papaverine salts and cenin salts combine in solution. The relation between the distribution number of cenin chloride and the concentration of the pigment seems to require the assumption that the molecules of the anthocyanin are associated (2 mols.) in aqueous solution and free in amyl alcohol. Chrysanthemine and idæin behave similarly, also malvidin 3-galactoside. This phenomenon appears to be related to that of co-pigmentation.

The naturally occurring co-pigments include the anthoxanthins (flavone and flavonol saccharides, etc.) and tannins and some efficient substances not yet identified.

The justification for assuming the operation of this factor can best be indicated by an example.

Certain herbaceous phlox contain pelargonin, but have a much bluer-red colour than other flowers coloured by this anthocyanin. But the same observation applies to the extract in 1 per cent hydrochloric acid, and moreover the presence of much anthoxanthin is noted. Hence, all the circumstances point to co-pigmentation of the pelargonin salt in the flower petal.

Finally, we do not know whether or not traces of iron and other inorganic substances may affect flower colour. In this connexion the case of the blue hydrangea is always quoted, and we have observed that when the stalks of red hydrangea flowers are immersed in very dilute aqueous ferric chloride, the flowers slowly become blue. The ashes of many flowers contain 1-2 per cent Fe_2O_3 , and the anthocyanin test for iron is one of the most delicate known.

Protection against Yellow Fever

THE discovery of a susceptible experimental animal for a human disease has rarely been followed by such a rapid development of practicable methods of control as in the case of yellow fever. The results of laboratory investigations since 1927, when Stokes, Bauer and Hudson found that certain species of Asiatic monkeys, *Macacus rhesus* and *M. sinicus*, could readily be infected with this disease, have elucidated most of the essential facts necessary for its control. Not the least of these discoveries has been the development of practicable methods of immunisation, and it is of interest to trace the successive stages leading up to this result.

The pioneer work of Hindle¹ showed that when yellow fever virus is exposed to the action of various agents such as formaldehyde, or phenol and glycerine, or simply kept exposed to air, it gradually loses its virulence and then passes through a phase when its inoculation into susceptible animals is followed by the development of immunity without any clinical signs of infection. Further exposure to the action of these agencies leads ultimately to the disappearance of all antigenic properties, and animals inoculated with such material failed to develop any immunity against the virus.

Although this method of protection gave very promising results with monkeys, and was used with success by Aragão in combatting the yellow fever epidemic in Rio de Janeiro in 1928, later experiments showed that there were considerable practical difficulties in estimating the exact degree of attenuation necessary to convert the virus into a vaccine. Moreover, at ordinary ice-box temperatures the vaccine soon lost its protective properties.

The persistence of a high degree of immunity after recovery from an attack of yellow fever is well known and serum from recovered patients has often been used in order to confer a passive

immunity. The protection following such an injection, however, does not last more than a few weeks, and consequently is of little practical value except when it is necessary to protect anyone recently exposed to infection.

In marked contrast with the short duration of this passive immunity, is the strong and lasting protection following the injection of virus and immune serum, and this method has been recommended by Aragão, and Findlay and Hindle, as an alternative to the use of a vaccine. The method was used with success by Aragão in the protection of a few human volunteers, but the possible risks of fully virulent yellow fever virus precluded its use except in isolated cases.

The practical difficulties in the application of this method have been largely overcome by the important discovery (Theiler, 1930) that after a few passages in the brains of mice, yellow fever virus loses to a great extent its power of producing a general infection in man or monkeys, and acquires neurotropic properties. This so-called 'mouse virus', if inoculated subcutaneously in small doses of 1:1,000 to 1:10,000 of a mouse brain suspension, generally fails to produce any serious reaction, but the inoculation is followed by the development of immunity against the ordinary yellow fever virus approximating in intensity that found in recovered cases of the disease. Sellards and Laigret recommended this as a method of vaccination, but further observations have shown that the inoculation of mouse virus is not unattended with risk, and yet a further objection is the circulation of the virus in the blood, so that the patient would be a possible source of infection for susceptible mosquitoes. Sawyer, Kitchen and Lloyd², using a mixture of mouse virus and human immune serum, have elaborated a technique whereby the objections to the last two methods of protection have been largely overcome.

A ten per cent suspension of infective mouse brain in human immune serum is passed through a Seitz filter and the filtrate placed in sterile tubes and dried in the frozen state *in vacuo*. After sealing the tubes, the dried virus will preserve its properties for many months if kept in a refrigerator. When required for use the tube is opened and the dried contents mixed with sterile distilled water. The human immune serum is collected either from patients who have recovered from an attack of yellow fever or from vaccinated persons. The titre of the immune serum is determined by protection tests in mice, which gives a means of estimating the necessary amount to be injected. The patient is inoculated subcutaneously with a dose of 0.5 c.c. per kilo body weight of human immune serum of a titre 1:256 to 1:512, or 0.3 c.c. per kilo if the titre of the serum is higher, so that the average dose for an adult man is 35 to 45 c.c. A few hours later this is followed by an injection of the dried mouse virus redissolved in distilled water, the dose being approximately 0.003 gm. per kilo body weight.

This method of protection has been applied with success by Dr. Sawyer and his colleagues in New York, and by Dr. G. M. Findlay in London. In every case that has been tested the vaccination

has been followed by the development of a high degree of immunity against yellow fever, and with a few doubtful exceptions the symptoms following vaccination have been absent or slight, and no virus has been detected in the blood circulation.

The only objection to the general application of this method is the practical difficulty of obtaining the necessary quantities of human immune serum, since this must be collected either from a patient recovered from yellow fever, or from a vaccinated subject. This objection seems to have been overcome by Pettit and Stefanopoulo³, who showed that the serum of horses or baboons inoculated repeatedly with yellow fever virus acquires anti-viral properties, and such serum may be used instead of human immune serum for the protection of human subjects. Moreover, these animal sera contain a much higher titre of immune bodies than human convalescent sera, and consequently it is not necessary to use such large doses. This method requires further tests before it can be recommended for general use, but it promises to furnish a safe and practicable means of immunising the population in regions where yellow fever is still endemic.

¹ NATURE, 125, 19, Jan. 4, 1930.

² J. Exp. Med., 55, p. 945.

³ Bull. Acad. Med., July 18, 1933.

Solomon's House

FRANCIS BACON left his name and memory to men's charitable speeches and to foreign nations, and the next ages. Safely and, it may be hoped, confidently. Within a year or so, two biographies have been published—Mary Sturt's "Francis Bacon" and Charles Williams's "Bacon"—both inspired by a sane and impartial enthusiasm for their subject, warts and all. Sir Frederick Gowland Hopkins, in his presidential address to the British Association at Leicester, invoked Bacon's vision of Solomon's House "an organisation of the best intellects bent on gathering knowledge for future practical services". A great idea, the president admitted. The modern structure, Sir Frederick suggested, would have functions similar (*mutatis mutandis*) to Bacon's fancy. "A house devoid of politics, concerned rather with synthesising knowledge, with a sustained appraisal of the progress of knowledge, and continuous concern with its bearing upon social readjustments." Not restricted to scientific authorities alone, it would be "an intellectual exchange, where thought would go ahead of immediate problems".

An intellectual exchange! If this implies a talking-shop, a Parliament, it would correspond to nothing conceived by Bacon. "Here therefore," he wrote in a famous passage, "is the first distemper of learning, when men study words and not matter." Bacon had a horror of "frivolous disputations, confutations, and auricular traditions and impostures". Was the nation richer,

he asked, by one poor invention as a result of all the ancient learning? Let a new method be tried; let us bring in "industrious observations; grounded conclusions, and profitable inventions and discoveries".

Solomon's House, as portrayed by Bacon in "New Atlantis", left in manuscript unfinished—"the rest was not Perfected" are its last sad words—was to be the noblest foundation that ever was upon the earth, the 'Lanthorne of this Kingdome', dedicated to the works and study of the creatures of God. It was to seek "the Knowledge of Causes and Secrett Motions of Things; and the Enlarging of the bounds of Human Empire to the Effecting of all Things possible". On its staff were to be merchants of light, depredators, mystery-men, pioneers, compilers, dowry-men or benefactors, lamps, inoculators, interpreters of Nature, novices, and apprentices. Their work was to be practical rather than speculative. Bacon, in an apocalyptic vision, saw the scientific discoveries of a later age—the phonograph, microphone, aeroplane, submarine, synthetic perfumes, high explosives, artificial gems, weather forecasts, microscopical diagnosis, inhalation of gas. There have been in the history of science more remarkable specific predictions of future discoveries, such as the identification of helium on the earth twenty-six years after Norman Lockyer discovered it in the sun. But when we remember the state of scientific knowledge at the beginning of the seventeenth century, Bacon's prevision is amazing.

A Lord Chancellor in office or retired could not be expected to do much of the actual scientific work himself, though the *corpus* of his experimental observations is substantial. But he was eager "to set the machine in motion". On his last journey, from London to Highgate, he thought of an untried experiment on refrigeration. Stepping from his coach, he procured at a cottage the body of a hen and stuffed it with snow. As often happens to scientific researchers, especially into tropical diseases, he became the victim of the incidents of his own experiment. Seized by the cold, he was put to bed in the neighbouring house of Lord Arundel and died in a few days, on Easter Sunday 1626, choking and struggling with bronchitis. He was able to say in his last letter, dictated to his host, that "As for the experiment itself, it succeeded excellently well". It was all that mattered. As a dying gesture, he carried out a successful experiment. Some centuries were to elapse before this simple experiment became the corner-stone of a great industry.

Bacon's life from the time he left Cambridge was a protest against syllogisms, the raw material of the scholastic philosophers, the "babbling sophists", whose aim in life was "to overcome an opponent in argument"—or burn him, as happened

to Bruno, or immure him, as happened to Galileo. Bacon held that man's true mission was "to command nature in action". Like a great general, he planned the campaign in the "Advancement of Learning" and the "Novum Organum". First the facts of Nature "free and at large" must be collected. The synthesis, like Tipperary, was a long, long way. Bacon knew he would never write that final chapter; he looked to humanity to continue and even to complete the work, keeping their eyes always on the object and clearing their minds of cant. "The whole of Nature being explored and understood", his biographer, Charles Williams, writes, "the whole of its operations lying open, truth (so far as the nature of things was concerned) being flagrant and ostensible, the final declaration of that philosophy would be achieved".

Bacon aspired after truth, "Immortal, incorruptible, sovereign truth". But if we wish to know why he would set men "finding out the true nature of all things", and create a Solomon's House for this great work, why not look for the reasons in "New Atlantis"? There they are, bell-clear, convincing—"whereby God might have the more glory in the workmanship of them, and men the more fruit in the use of them". T. L. H.

Obituary

MAJOR C. K. COCHRAN-PATRICK, D.S.O., M.C.

THE daily Press has recorded the aeroplane disaster at Johannesburg on September 26 which resulted in the deaths of Major C. K. Cochran-Patrick, and his companion, Sir Michael Oppenheimer, a member of a family well known on the Rand. That a pilot of the highest skill, with vast experience of flying in four continents, should crash immediately after taking off from an aerodrome, must be attributed to some peculiar laxity or abnormal circumstance. The loss of a life so valuable is particularly regrettable, since after attaining the highest reputation in the military sphere, it was hoped that Cochran-Patrick would attain to similar eminence in promoting the more scientific development of civil aviation, especially in the realm of air survey wherein his later interests chiefly lay.

After undertaking some pioneer work in Venezuela, Cochran-Patrick went to Burma to photograph from the air the delta of the Irawadi. Here there was much illegal cutting of the valuable teak forest, but in the absence of a proper map of the area it was impossible to assess the extent of the damage or control the depredation. The area was very difficult of access and survey by ordinary methods was next to impossible. The air photographs taken by Cochran-Patrick, in conjunction with trigonometrical surveys of the creeks executed by Lieut.-Col. Lewis of the Survey of India, resulted in the successful mapping of the whole area; even the photographs themselves

were of the greatest value to the Forestry Department, since it was then proved conclusively that the several types of vegetation could be differentiated on the prints. Apart from survey itself, a new use was thus found for air photographs. We consider this to have been Cochran-Patrick's most fruitful civil work; moreover, it pointed out conditions under which air survey could be employed with greatest success.

From the Air Survey Co., Cochran-Patrick transferred his services to the Aircraft Operating Co. and carried out surveys for the latter in Rhodesia, Iraq and elsewhere. Perhaps his most interesting job in Rhodesia was the photographic survey of the upper tributaries of the Zambezi River in order to study its hydrology; much useful information was thus gained without the delays and dangers consequent on painful penetration. Further work was accomplished in Northern Rhodesia in areas where mineral development was in progress and land settlement was proposed.

In the intervals between these surveys in the field, Cochran-Patrick was engaged in seeking the improvement and quickening of technical processes. If he did not himself discover a new method of air survey, at any rate he applied himself actively to the development of methods already in existence; improved means of handling large mosaics of photographs and constructing the map therefrom demanded patient research and detailed study of processes. The loss of Cochran-

Patrick, brave and modest, has occurred in the prime of life, at the early age of thirty-seven years; his departure will be deplored by a large circle of friends.

PROF. R. RAMSAY WRIGHT

WE regret to record the death on September 5 of Robert Ramsay Wright, emeritus professor of biology in the University of Toronto. Prof. Wright was a child of the manse and was born at Alloa, Scotland, in the year 1853. His early education was obtained at the Edinburgh High School, whence he proceeded to the University of Edinburgh, receiving in due time the degrees of M.A. (1871) and B.Sc. (1873). He acted for a time as assistant to the professor of natural history at Edinburgh, but in 1874 he was called to the University of Toronto to succeed Prof. H. A. Nicholson in the chair of natural history, his title being later changed to professor of biology.

Prof. Wright proved to be an attractive and inspiring teacher, and early introduced practical instruction on the lines developed by Huxley and Martin. The growth of his department soon called for more suitable accommodation than was at first available, and he planned and carried to completion the erection of a Biological Building, which included an unusually complete teaching Museum of Zoology and from which Departments of Botany and Physiology later budded off. His administrative abilities led to his appointment in 1901 to the office of vice-president of the University, an office which he retained until his retirement from active service in 1912, when he returned to Great Britain and took up his residence in Oxford.

Administrative duties seriously interfered with

Prof. Wright's marked ability for research, shown by his early contributions to Canadian helminthology and later by his studies of the so-called auditory apparatus of the siluroid fishes. With the collaboration of some former pupils, he published a polygraph of the anatomy of the catfish (*Amiurus catus*), he himself supplying the sections on the nervous system and sense organs. But his interests were very broad; he was a musician of no mean order and an exceptional linguist; indeed, his latest completed work was a translation of a Persian medical MS. by al-Biruni.

Recognition of Prof. Wright's attainments was frequent, both from Canada and from his motherland. He received the honorary degree of LL.D. from Edinburgh and Toronto and an honorary M.A. from Oxford. He was president of the Canadian Institute in 1893-95 and contributed on occasion to its *Proceedings*; he was a charter fellow of the Royal Society of Canada and its president in 1910-11, and as an original member of the Biological Board of Canada he played an important part in the establishment and development of that organisation. Canadian biology owes much to his enthusiasm, his stimulating teaching and his scholarship. J. P. McM.

WE regret to announce the following deaths:

Sir Arthur Mayo-Robson, K.B.E., C.B., C.V.O., emeritus professor of surgery in the University of Leeds, and honorary president of the Surgical Section of the Thirteenth International Medical Congress in Paris in 1900, on October 12, aged eighty years.

The Hon. Lady Parsons, widow of the late Sir Charles Parsons, and one of the founders of the Women's Engineering Society, on October 16.

News and Views

Centenary of Alfred Nobel, 1833-1896

ON October 21 occurs the centenary of the birth of Alfred Bernhard Nobel, the eminent Swedish engineer, inventor and industrialist, who left the greater part of his fortune to found the Nobel prizes. He was the third of the four sons of Emmanuel Nobel (1801-72) who for many years had works in St. Petersburg, where contracts were carried out for the Russian government, and like his brothers, Alfred was trained in his father's shops. At an early age, his attention was attracted to the subject of explosives, which had entered upon a new phase of development through the invention in 1846 of gun-cotton by Schönbein and of nitro-glycerine by Sobrero in the following year. Experimenting with these new substances, Nobel discovered that nitro-glycerine can be detonated by a small charge of fulminate of mercury, and next found that by mixing nitro-glycerine with the porous earth kieselguhr, he could produce an explosive in a form which could be

handled easily and safely. To this substance, which he patented in Sweden on September 19, 1867, he gave the name 'dynamite'. In later years he produced blasting gelatine, ballistite and other explosives, for the manufacture of which works were erected in many parts of the world. Some of Nobel's wealth was derived from his association with his elder brothers, Hjalmar Nobel (1829-1896) and Ludwig Nobel (1831-1888) in their remarkable exploitation of the Baku oil fields and their methods of transporting oil by pipe lines, tank cars and tank steamers. Nobel's death took place at San Remo on December 10, 1896, and by a will which was signed in 1895, about £1,400,000 became available for the foundation of the famous prizes awarded annually for notable work done in physics, chemistry, medicine or physiology, and literature and in the cause of peace. The first awards were made on December 10, 1901, five years after Nobel's death.

Prof. J. Chevalier

PROF. JACQUES CHEVALIER, dean of the Faculty of Letters and professor of philosophy in the University of Grenoble, is to deliver a series of lectures in London, Cambridge and the north of England. He will speak at the Aquinas Society (Lecture Hall, Inner Temple) on Tuesday, October 24, at 8 p.m. on the "Revival of Realism in French Philosophy". On Wednesday, October 25, he will be the guest of honour at a luncheon given by the Philosophical Society at the Lyceum Club. On Thursday, October 26, at 5.30 p.m. he will lecture on "Descartes" at University College, Gower Street, London; and on the following Saturday at 3 p.m. he will speak on the "Problem of Survival" at the Institut Français (3 Cromwell Gardens, S.W.7). Prof. Chevalier has many friends in England where he has often been at the invitation of the Universities of Oxford and of London or as a delegate to learned congresses. His first visit in England was in 1904, when he came over to study, returning to France with a remarkable monograph on the religious revival in Wales. This brilliant work, with which he began his philosophical career, was soon followed by a penetrating study on the notion of necessity in Aristotle's philosophy. But he is better known in Great Britain by his three monographs on Descartes, Pascal and Bergson, which he has written since he has held the chair of philosophy in the University of Grenoble. He shows how their doctrines affect present-day problems, and gives an original interpretation of them.

CHEVALIER'S fundamental views are admirably expounded in his latest two works, "L'Idée et le Réel" (Arthaud, Grenoble, 1932) and "L'Habitude" (Boivin, Paris, 1933); while his ethical teaching is sketched in two pamphlets, "Notes sur les fondements de la vie morale" (Cahiers du Van, Lyon, 1932) and "Notes sur le moteur de la vie morale, l'Amour" (Cahiers du Van, 1933). They form a harmonious whole. As a philosopher Prof. Chevalier is a realist, holding that every object of knowledge is partially given by the external world and partially constructed by the mind. The results of this synthesis, however, are but a pale reflection of the ideas which we relentlessly try to seize in their totality and which find in God the reason of their subsistence. This dependence of the sensible on the ideal suggests at once an ordered universe in which moral conduct and free will have an appropriate place. The gift of free will allows us to follow the order of things as well as rebel against it. Man sins when he uses his liberty to deviate his love towards the base attractions of the sensible world, while he gets his ultimate reward when he uses his free will to choose the good from the evil and to return his love to God. The inspiration of the Greek and medieval thinkers is thus prominent in Prof. Chevalier's line of thought; and it is with this inspiration that he has become one of the most effective heralds of the realist revival in France.

Archæology in Iraq

THE first annual general meeting of the British School of Archæology in Iraq (Gertrude Bell Memorial), which was held in the rooms of the Society of Antiquaries on October 10, not only served to mark the success which has attended the launching, in times by no means favourable, of an undertaking commemorating one whose name will always be associated with the study of the past in Mesopotamia; it was also an occasion which will be memorable in the annals of the School for the significance of the topics, each in its respective category, which were discussed. First of these was the welcome announcement, made by Sir Bonham Carter as chairman of the Executive Committee, that the School is shortly to issue a journal of its proceedings under the editorship of Mr. Sidney Smith, keeper of Egyptian and Assyrian antiquities in the British Museum. This step will consolidate the position of the School and extend its sphere of utility considerably. In conjunction with the further proposal for the institution of a school and hostel in Iraq, which was discussed, but unfortunately remains in abeyance for the moment, it should set British students in Iraq well on the way to the advantages enjoyed by members of the sister institutions in Rome, Athens and Jerusalem. Of the results which it will be open to these students to achieve, a foretaste was offered by Mr. M. E. L. Mallowan's account of his excavations at Arpachiyah, the School's first expedition, which, by demonstrating the essential unity of a culture extending from Crete to India, has made what may well prove a crucial contribution to the study of prehistory in the Near and Middle East.

To so much that was encouraging Sir Bonham Carter was unfortunately constrained to add a discordant note. Owing to the action of the Ministry of Education in Iraq, the antiquities from Arpachiyah have not yet been allowed to leave the country, and it has not been possible to hold the projected exhibition, much to the disadvantage of scholars who wish for an early opportunity to examine the material at first hand. After the allocation of antiquities from the excavation as between the Bagdad Museum and the School, the latter receiving less than half, and after Mr. Mallowan had packed his material and was on the point of leaving the country, the Minister of Education expressed dissatisfaction with the division and refused the necessary permit to export. In the meantime, a new antiquities law has been drafted for submission to the Iraqi Parliament in November. In the circumstances, therefore, it is not surprising that the Committee of the School has decided that it is unable to finance further expeditions unless there is assurance that fair and reasonable conditions will be allowed to excavators. The fear expressed that other bodies interested in archæological research will follow this example will only too certainly be justified. Such situations are bound to arise so long as there are governments over-jelous of their rights, and exploiters of excavation

—we will not say archæologists—whose one desire is to get valuable museum pieces out of the country.

Spurious University Degrees

UNFORTUNATELY, there is little prospect of any further progress being made during the present session of Parliament with the University Degrees Bill, promoted by the Association of Scientific Workers. The Bill received its second reading in the House of Lords in July, and Lord Jessel, who was in charge of the measure, deferred its committee stage until November 7 in the hope that the university authorities would meanwhile give their support to the Bill, or alternatively give constructive support by suggesting amendments. There was every desire on the part of the promoters that any amendments emanating from the university authorities should be accepted, and incorporated in the Bill in order to make it an agreed measure. It was not to be, however, and as Government acquiescence in the Bill was conditional on university support, it will probably be decided to withdraw the Bill this session, and to endeavour to formulate another agreed Bill by negotiation. Needless to say, the University authorities are not opposed to the principle of the Bill. Their main objection was to the provision which made it necessary for the holders of overseas degrees to state their origin, feeling that differentiation in this manner was not desirable. It may be that the solution will be found in enacting that the holders of all degrees should be liable to state the origin of their degrees. That would avoid differentiation.

THE Association of Scientific Workers is, we understand, to proceed with its endeavours to do away with the scandal of these bogus degrees and the consequent exploitation of the public. Drafting legislation on the subject bristles with difficulties. It is easy to legislate for British subjects bearing degrees purporting to be conferred by universities in the United Kingdom. The difficulty is to define what should be a recognised university outside the United Kingdom. Obviously it is not possible for the British Parliament to control the actions of foreign universities. It should, however, prove possible to legislate controlling the use of the degrees of such foreign universities in Great Britain. A university degree forms part of the coinage of civilisation and culture; and it should be just as illegal to tender spurious degrees as it is to tender counterfeit money. The continuance of this scandal does nothing to add to the dignity of our universities, while to graduates forced to market their abilities in competition with the bearers of spurious degrees—in the scholastic, journalistic, and scientific worlds—the whole subject is one of vital economic importance.

The Capybara, the Largest Living Rodent

THE Gardens of the Zoological Society of London have just been enriched by the addition of specimens of the capybara, or carpincho (*Hydrochoerus capivara*) the gift of Mr. Alfred Ezra. The capybara is one of the most interesting as well as by far the largest

of living rodents. Full grown specimens attain a length of 4 ft., and a weight of 100 lb. But fossil remains of even larger species have been found in the Pleistocene of Buenos Ayres, one of which is estimated to have been 5 ft. long. The capybara, which belongs to the same family as the guinea-pig, has a covering of long, coarse hair, reddish-brown above, and brownish-yellow below. It ranges over the whole of eastern South America, and westwards into Peru and Bolivia. Thoroughly aquatic in its habits, it is always found on the margins of streams and lakes, concealed among the reeds and other water plants. Its principal natural enemies are anacondas and jaguars. But a new danger has overtaken the capybara, since its skin, said to resemble pig skin, is now being placed on the market for saddlery. There is always a grave danger when animals, by no means numerous, come within the range of commercial enterprise. Should the demand for skins increase, the extermination of this most interesting animal will speedily follow. Zoologists should, therefore, enlist sympathetic and practical protective measures on the part of the government concerned. Another addition to the Gardens worthy of note is six Indian blackbuck, also presented by Mr. Ezra. They will eventually be sent to Whipsnade, where it is to be hoped they will breed: for this fine antelope is by no means common in India, and needs protection.

Protection of the Fauna and Flora of Africa

AN international conference to consider measures for the protection of the fauna and flora of Africa will meet in London on October 31. The meetings will be held in the Moses Room at the House of Lords and will be presided over by the Right Hon. the Earl of Onslow, who will also be the chief delegate of His Majesty's Government in the United Kingdom. The Government will also be represented by Sir William Gowers, Senior Crown Agent for the Colonies, Sir Arnold Hodson, Governor of Sierra Leone, and Mr. A. B. Acheson, of the Colonial Office. Representatives of the Governments of the Union of South Africa and of Southern Rhodesia will attend. Other Governments to be represented are those of Abyssinia, Belgium, Egypt, France, Italy, Portugal, Spain and the Anglo-Egyptian Sudan. The Government of India, the Netherlands Government and the Government of the United States have nominated observers to attend the Conference. The secretary of the conference will be Mr. Francis Hemming, joint secretary, Economic Advisory Council, with Mr. D. H. F. Rickett as assistant secretary. The address of the secretariat will be 2 Whitehall Gardens, London, S.W.1.

THE chief task of the conference will be to draw up a revised international convention for the protection of the fauna and flora of Africa. In this connexion, it will be recalled that a resolution was passed at the International Congress for the Protection of Nature, which was held in Paris in the summer of 1931, urging that the question of the negotiation of a new international convention should be considered by the Powers concerned. A draft convention has been prepared by His Majesty's

Government in the United Kingdom and circulated to the other governments participating in the Conference to be used as a basis for discussion. This draft contains suggestions for an agreed declaration of principle on the subject of the establishment of national sanctuaries in which wild animals and plants may be preserved with due regard to the interests of the native inhabitants of the various territories concerned. It contemplates the adoption of concerted measures of control designed to restrict the killing of some of the rarer species of animal in Africa and to prohibit the unregulated traffic in trophies obtained from such animals. It also deals with various objectionable methods of hunting and other practices which have a destructive effect upon wild life, and is designed to secure co-operation between the various administrations concerned and the free exchange of information on all questions relating to the protection of the natural fauna and flora of Africa. It is anticipated that the plenary sessions of the Conference will be held in public.

Oil an Ally of Coal

OIL is familiar to us as a competitor with coal, but Sir John Cadman, in the Melchett lecture delivered on October 11 before the Institute of Fuel, showed that there is another, and important, aspect of the relation between the two fuels. He unhesitatingly rejected the view that the advent of oil and the development of oil-consuming mechanisms have brought no advantages to coal. Virtually, every part of every motor-vehicle constructed in Great Britain represents a consumption of coal. Without oil and the lubricants which it supplies, the industrial demand for coal would almost cease to exist. The future of the coal industry, in Sir John Cadman's opinion, depends more and more on a progressively greater adaptation of science to the problem of its transformation into power. It is essential that coal should be converted from a solid mass into a fluid, and for this purpose two processes are available; the first is gasification, and the second, perhaps, hydrogenation. In gasification, which effects only a partial transformation from solid to fluid, the loss of energy involved is approximately 20 per cent of that contained in the material treated and consumed. In hydrogenation, however, the loss is more than 60 per cent, and the object achieved is the production of a substance which, at the present time, Nature itself is yielding in plethoric quantity. But whatever the merits of the process may be, it is a matter of the first interest to the coal industry that it should be tested. The test is being carried out by the chemical industry instead of by the coalowners, and if the process succeeds, doubtless the chemical industry will reap the main benefit. However, encouragement of research by colliery owners and coal merchants and their stimulation of the introduction of scientific coal-burning appliances are important steps in the right direction.

Copper in Architecture

LECTURING on October 12 to the Association of Architects, Surveyors, and Technical Assistants, Dr.

W. H. J. Vernon, of the Chemical Research Laboratory of the Department of Scientific and Industrial Research, referred particularly to the composition, properties, and artificial reproduction of the attractive green patina which appears on copper on long exposure to the atmosphere. In this respect, copper is unique among roofing materials. Urban samples of patina have been found to consist essentially of basic copper sulphate, and not of copper carbonate as was previously supposed. Evidently sulphur dioxide is the predominant atmospheric factor in its formation, a view which is supported by the fact that the patina is more difficult to produce in rural districts than in towns. The material first formed is the normal copper sulphate which, being soluble in water, causes disfigurement of stonework underlying copper or bronze statues. After about seventy years, however, the film has been converted into a substance of composition similar to that of the mineral brochantite, the only basic copper sulphate which occurs in Nature. Thereafter the composition appears to remain constant for periods of exposure up to three hundred years. The attainment of a uniform green colour by atmospheric exposure is preceded by a period of ten to twenty years, during which the metal presents an unsightly black appearance owing to the presence of sulphide, oxide, and carbonaceous matter. The period of unsightliness can now be eliminated by subjecting the copper to electrolytic corrosion under controlled conditions; after 15 minutes an insoluble patina of good green colour is produced, and this, after exposure to the air, is found to have approximately the constitution of brochantite. By far the best results are obtained with arsenical copper, and it is significant that all the old copper roofs which have been analysed are also arsenical.

Association of British Chemical Manufacturers

BRITISH chemical manufacturers have recently received the seventeenth annual report of their Association, the president of which is Mr. C. A. Hill. Speaking at the annual general meeting on October 12, Mr. Hill referred in particular to the results of the Ottawa agreements and to the continued need for co-operation under the British flag. The attitude of the Association towards tariff questions is essentially scientific. Its representatives went to Ottawa knowing exactly what they wanted and, broadly speaking, their efforts met with success. In the past year, their work had been followed up by a second visit to settle outstanding matters of detail and to consolidate the ground previously gained. Mr. Hill emphasised that time is required for the full benefits of the Ottawa agreements to become apparent; the agreements should be regarded only as the beginnings of closer Empire co-operation and should be flexible and capable of adjustment to changing circumstances. He referred appreciatively to the report of the Advisory Committee on the Dyestuffs Act; its recommendations call for a continuance, without any set period of time, of the present system of prohibition and licences for dyestuffs and their intermediates. The annual report refers also to exhibitions and means for bringing the activities and products of the

chemical industry before the notice of the public. "The industry can only expect legislative support," it says, "provided that Parliament and the public understand what it is doing." The Association's principal directory, "British Chemicals and their Manufacturers", which is distributed in large numbers throughout the world, and the "Directory of British Fine Chemicals", which has also been revised, are greatly in request by firms and trade organisations overseas, one country after another turning to Britain for supplies of products hitherto bought elsewhere. The Association continues to support the work of the chemical division of the British Standards Institution, and it is satisfactory to note that the new organisation is making excellent progress.

Diesel Engines for Road Transport

A REMARKABLE revolution is taking place in the type of engine used in large motor vehicles, and by some it is thought that for road transport the high-speed oil engine is destined to supersede the long-favoured petrol engine. The various aspects of the subject were dealt with in a paper read to the Institution of Petroleum Technologists on October 10 by Mr. W. A. Goddard, entitled "The Modern High-Speed Diesel Engine, and its Place in Road Transport". It was only in April 1928 that the first heavy lorries fitted with Diesel engines were put to work in Great Britain, but to-day Diesel engines for road vehicles are being turned out at the rate of 80-100 per month, while the number of vehicles with Diesel engines in use is more than two thousand. Foremost among those who have adopted Diesel engines are various corporations and omnibus companies; the former London General Omnibus Company had about 112 Diesel-driven buses in regular use. With the high-speed oil engine there is economy in fuel consumption, immunity from fire risks, greater ease in starting when cold, enhanced acceleration and a reduction in carbon monoxide in the exhaust gases. Diesel engines are now being constructed for running at 1,700 r.p.m., and the fuel consumption has been brought down to 0.37 lb. per h.p. per hour. At the present time 'gas oil' costs about 5½d. per gallon, as compared with commercial petrol at 1s. 1d. per gallon, while a 'double-decker' bus with a Diesel engine will run 11 miles per gallon as against about 6 miles per gallon with a petrol engine. A recent test over 20,000 miles carried out by a corporation in the north of England showed that the Diesel engine led to a saving of about £600 a year. "The high-speed Diesel engine," said Mr. Goddard, "has passed through its testing period with flying colours, and is undoubtedly the engine of the future for road transport."

Value of Technical Museums

MR. H. W. DICKINSON delivered his presidential address to the Newcomen Society on October 11, taking as his subject "Museums and their Relation to the History of Engineering and Technology". After tracing the ideas about museums up to the seventeenth century, Mr. Dickinson introduced his review of the growth and aims of technical museums

by quoting from the "New Atlantis", in which Francis Bacon set forth his plans for a museum of inventions and a portrait gallery of inventors. Such a museum remained but a phantasy for many years, but in the eighteenth century the Society for the Encouragement of Arts, Manufactures and Commerce, founded in 1754, formed a repository of machines, while in the United States the patent acts of 1790 and 1793 laid down that patentees should deposit models of their inventions. In France, too, with the inauguration in 1794 of the Conservatoire des Arts et Métiers, the machines collected by Vaucanson and the apparatus belonging to the Paris Academy of Sciences were combined to form the nucleus of the present collections housed in the old Priory of St. Martin-des-Champs.

IN England, the Exhibition of 1851 gave a stimulus to the exhibition of objects illustrating the application of art and science. But the most important steps towards the realisation of a technical museum were taken by Bennet Woodcroft (1803-79), who under the Patent Law Amendment Act of 1852 became Superintendent of Specifications. The Patent Museum which he established at South Kensington formed the nucleus of the machinery collections now to be seen in the Science Museum, while his collection of biographical material is at the Patent Office Library. Woodcroft did the nation great service by securing some of the most valuable historic engines and machines. After his time, the Patent Museum fell on evil days and was rescued from neglect by William Isaac Last (1857-1911), who as keeper of the Section of Machinery and Inventions of the South Kensington Museum introduced a new technique in museum work, sectioning the models and making them workable, and thus rendering them of great educational value. His ideas have borne much fruit and have influenced museum technique at home and abroad. After referring to the aids afforded by technical museums, Mr. Dickinson urged upon the members of the Newcomen Society the desirability of assisting in various ways the work of both national and local museums.

Engineers' Study Circle on Economics

FOLLOWING an informal meeting of members at the Institution of Mechanical Engineers, when the subject of economics in its relationship to engineers was discussed, Mr. John L. Hodgson, author of "The Great God Waste", initiated the formation of an Engineers' Study Circle on Economics. The group so formed now includes civil, mechanical, electrical and chemical engineers, and it is hoped to extend it so as to include members of other branches of engineering and allied professions. The group has already done a certain amount of work in the direction of a critical survey of the productivity of Great Britain, and other matters, and meets fortnightly at the Guild-house, Eccleston Square, London, S.W.1. The main object of the group is to discuss and consider what changes may be necessary to enable the community to benefit by the technical and scientific advances in knowledge and productivity

now available. Col. Philip Johnson, Gunnersbury House, Hounslow, Middlesex, and Mr. W. J. Marshall, 12 Blakesley Avenue, London, W.5, are the joint secretaries of the group.

The Algiers-Oran Railway

IN northern Africa the poor quality of the water obtainable makes it very difficult to run steam trains. We learn from the *Electrician* of October 13 that the P. L. M. Railway asked the Société Générale 'Alsthom' of Belfort to construct a Diesel electric locomotive to be used for hauling a passenger train from Algiers to Oran. It was specified that the speed was to be more than 66 miles per hour, and, as the air temperature rises to 122° F. and sandy conditions are met with, stringent conditions were laid down. To meet these requirements, Alsthom have built a locomotive with a 920 horse power Diesel motor which has eight cylinders and a speed of 700 revolutions per minute. The electrical system comprises a generator which furnishes current to three motors each driving an axle. The running is entirely automatic, so the driver can concentrate his attention on the signals. The locomotive was tested on the Paris-Marseilles line. The tank holds 519 gallons, 322 gallons being consumed in the journey, which lasted less than nine hours. The speed attained averaged about 75 miles per hour.

Fruit-growing Survey

BULLETIN No. 61 of the Ministry of Agriculture and Fisheries deals with the "West Cambridgeshire Fruit-growing Area". (London: H.M. Stationery Office, pp. 1-83. 1s. 6d. net.) This is the third of a series of detailed surveys into the relation between climate, soil and fruit-growing in England. Previous surveys dealt with the West Midlands and the Wisbech area. Part I of the Bulletin deals very fully with the soils of the area, whilst Part II traces the history of fruit-growing and describes its practice. Part III studies the relation between soils and fruit, and embraces both top fruits and soft fruits. Many interesting points are brought out in this section, one of the most striking being the relation between the iron-calcium ratio and chlorosis of strawberry plants. Appendix B gives the necessary rainfall records and an extensive bibliography is added. The Bulletin presents a large amount of data which is of direct importance to the fruit grower in the area under review and of great interest to growers in other parts of England.

The Royal Scottish Museum

IN spite of restrictions due to curtailment of grants, the activities of this Museum in Edinburgh have proceeded satisfactorily during the past year. The numbers of visitors attending the gallery demonstrations and of school children attending special lectures have fallen slightly; but the total number of visitors shows an increase. The Museum, as a branch of the Scottish Education Department, is co-operating in the Department's effort to make museums throughout the country of more service to

the public and to schools; and it collaborated with the British Broadcasting Corporation in exhibiting special illustrations of broadcast talks, particularly on natural history. During the year a bronze plaque to the memory of Drs. Peach and Horne was unveiled by Sir John Flett; and a very successful exhibition illustrating the apparatus and the methods of meteorology was held for three months.

The Haffkine Institute, Bombay

THE report of the Haffkine Institute for 1931, recently issued, by the Director, Lieut.-Col. J. Taylor, reviews the year's work. The Institute is now the centre for the manufacture of plague vaccine for the whole of India, the output of which for the year was 882,640 doses. For the Bombay municipality, 626,045 rats were examined, of which 425,697 were found dead, and of these 748 were plague-infected. The present low level of the plague epizootic among rats coincides with a low incidence of human cases—only 20 plague deaths for the year. When plague was prevalent in 1923, the corresponding figures were 8,476 rats dead of plague, with 928 human deaths from plague. In the Anti-Rabic Department, 1,061 cases of bites by rabid animals were treated, with a mortality of 0.28 per cent.

Electrical Automatic Water Still

MESSRS. BAIRD AND TATLOCK (LONDON), LTD., 14 Cross Street, Hatton Garden, E.C.1, have put on the market an interesting electrically heated automatic water still. The smaller size, which costs £6 13s. 6d., produces four pints of distilled water an hour with a consumption of 1,500 watts. The still is designed to allow easy access to all parts, a great advantage when hard water is used. It is fitted with an automatic safety device to cut off the current should the water supply fail, and there is heat interchange between the incoming cold water and the outgoing steam.

Seeding of Frog-bit in Great Britain

IN NATURE of November 5, 1932, p. 694, reference was made to the fact that seeds of frog-bit, *Hydrocharis morsus-ranæ*, had matured in the botanical garden of the Royal Holloway College for Women, Englefield Green, Surrey. Fruits of the frog-bit have again been found in the same water garden, due possibly to the exceptionally good season for aquatic plants. It is proposed to make another attempt to germinate the seeds and to determine if the frog-bit is a dioecious or a monoecious plant.

Jubilee Volume of the Society of Dyers and Colourists

IN connexion with the jubilee celebrations next year at Whitsuntide of the Society of Dyers and Colourists, a volume is being prepared dealing with the history, progress, and present position of every phase of the dyeing, dyestuff, and textile printing industries. The contributors are of international repute, and it is hoped that the volume will prove a landmark in the history and literature of the tinctorial arts and industries. The Society, the

offices of which are at 32 Piccadilly, Bradford, would be glad to have its attention directed to matters of importance, historical or otherwise, which may be of interest in the preparation of the volume.

Liverpool Geological Society's Medal

DR. EDWARD GREENLY has been awarded the Liverpool Geological Society's medal, which is given for "outstanding geological work connected with problems bearing upon the work of the Society". Dr. Greenly laboured at his own expense for twenty-four years in the elucidation of the geology of Anglesey, and produced at the end of that period his famous memoir, which has been described by the Director of the Geological Survey as "not only the standard work on Anglesey, but a work of reference in several branches of geological research for years to come". This remarkable tribute rightly describes the work of one who has given his life to the determination of the age relations of the rocks of Anglesey and the interpretation of the structure of the Mona Complex.

R.R.S. *Discovery II*

THE Royal Research Ship *Discovery II* has just left London on its third antarctic commission. The vessel is engaged in oceanographic work, mainly directed towards the elucidation of whaling problems, and during the first season of the present commission will be largely occupied in the examination of a belt of ocean, some 200 miles in width, along the Pacific ice-edge between Cape Horn and New Zealand, a region from which very little information has hitherto been obtained. On the outward passage, *Discovery II* will call at Tristan d'Acunha and will refit at Cape Town in June, 1934. The work is directed by the Discovery Committee acting under the instructions of the Secretary of State for the Colonies on behalf of the Government of the Falkland Islands. Dr. N. A. Mackintosh will be in charge of the scientific work, with Capt. A. L. Nelson in executive command.

King John's Treasure

WE have received the following letter signed by Mr. Gaspard Ponsonby, Lord Francis Hill, Dr. Mortimer Wheeler, keeper of the London Museum, Dr. A. F. Hallimond, of the Geological Survey, and Mr. O. G. S. Crawford, archaeological officer of the Ordnance Survey: "With regard to the various references which have appeared from time to time in the daily Press, we should be glad if you would afford us this opportunity of stating that we have severed all connexion with Fen Research Limited and the project for the recovery of the above treasure."

Announcements

MR. RAMSAY MACDONALD will open the extension of the Dollis Hill Research Station of the General Post Office, which is devoted to investigations on communication services, on October 23.

PROF. G. T. MORGAN, director of research at the Chemical Research Laboratory, Teddington, will

deliver a lecture before the Institution of Chemical Engineers entitled "Engineering in the Service of Chemical Research", on October 27, at 6.30 p.m. at the Institution of Civil Engineers. The meeting is open to the public, for whom tickets may be obtained from the Assistant Secretary, Institution of Chemical Engineers, Abbey House, Westminster, London, S.W.1.

DR. R. E. STRADLING will deliver a lecture in the series "Physics in Industry" before the Institute of Physics at the Royal Institution, 21 Albemarle Street, London, W.1, on November 1, at 5.30 p.m. The title of Dr. Stradling's lecture will be "Physics in the Building Industry".

THE trustees of the Ray Lankester Fund have elected Prof. N. J. Berrill, associate professor of zoology at McGill University, Montreal, to be the Ray Lankester investigator at the Marine Biological Laboratory, Plymouth, from June 1, 1934. The subject of Dr. Berrill's research will be metamorphosis in ascidians and regeneration in sabellids.

THE twenty-fourth annual Exhibition of Scientific Instruments and Apparatus under the auspices of the Physical Society will be held at the Imperial College of Science and Technology on January 9-11, 1934. Evening discourses will be delivered during the Exhibition by Mr. R. S. Whipple, on "The Evolution of the Galvanometer", Mr. J. Guild on "The Instrumental Side of Colorimetry" and Sir Ambrose Fleming on "The History and Development of the Thermionic Valve".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in physical and inorganic chemistry at University College, Hull—The Registrar (Oct. 23). An assistant for work on technical records and publications at the Forest Products Research Laboratory, Princes Risborough—The Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, London, S.W.1 (Oct. 23). A part-time lecturer in electrical technology and elementary high frequency and audio frequency technique at the Polytechnic, Regent Street, London, W.1—The Director of Education (Oct. 23). A lecturer in chemistry at Portsmouth Municipal College—The Registrar (Oct. 31). A physiologist at the Rowett Research Institute, Bucksburn, Aberdeen—The Secretary (Oct. 31). An assistant lecturer in bacteriology at the Edinburgh and East of Scotland College of Agriculture—The Secretary, 13 George Street, Edinburgh (Nov. 3). A professor of pharmacology in the University of Sheffield—The Registrar (Nov. 10). A Sir William Dunn professor of pathology in the University of London—The Academic Registrar (Dec. 1). A Moseley research student (preferably physics or chemistry)—The Assistant Secretary of the Royal Society, Burlington House, London, W.1 (Dec. 2). An assistant master in engineering, drawing, applied mechanics and heat engines at Ponders End Technical Institute—H. M. Walton (T), Secretary, 10, Great George Street, Westminster, S.W.1.

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.]

Absorption of Cosmical Radiation

A CORRESPONDENT, Mr. Harris Booth, has questioned the validity of the treatment of the absorption curve of cosmical radiation in water as given in my "Inter-

my wife in 1910 for the γ -rays of radium¹. Mr. Booth points out that though the cases appear to be mathematically identical and very analogous philosophically, they are physically fundamentally different. In our case we started from the solution for a point source of γ -rays in contact with a plate of infinite area and finite thickness, T , and extended it for experimental examination to plates of the form of a truncated hemisphere of radius R . For cosmical rays absorbed by the water of a lake, each point on the surface may be regarded as a point source of cosmical rays if the radiation is indifferently directed.

I append Mr. Booth's solution, though he points out it is not "rigid", as intensity I means radiation per time per unit area in the enunciation and per unit volume in the solution, but this ambiguity seems to be inherent in our present ideas of radiation. Of more practical moment, perhaps, is the consideration that the absorption of the rays by the atmosphere, though at first sight a difficulty, can, if the sphericity of the earth is negligible, be accounted for, using the correct formula, in the usual way by adding to the depth of water below the surface that of a layer of water of weight equal to the atmosphere.

The formula, containing exponential and exponential integral terms, the latter computable from tables given by Glaisher², appears first to have been obtained by H. W. Schmidt, with the assistance of W. v. Ignatowski, in a paper on β -rays³, to which we showed it could not apply owing to scattering. Unfortunately, both Schmidt's and our solution, for which we were indebted to Sir Joseph Larmor, are marred by errors of copying, so that Mr. Booth's presentation should be followed.

Schmidt showed that above $\lambda T = 5$, where λ is the absorption coefficient and T the thickness or depth, absorption appears to proceed exponentially with a value for λ 1.16 times the true value. For thicknesses below $\lambda T = 2$ the rays appear much 'softer'. A graph, contrasting absorption for a parallel and hemispherical beam, $\log I$ being plotted against λT , is reproduced from our paper (Fig. 1). It shows how obliquity simulates heterogeneity. Indeed, it would seem practicable to treat it as the sum of separate exponential

curves. The other graph (Fig. 2) gives the experimental results for the γ -rays of radium using truncated hemispheres of lead and zinc. For the former the γ -rays of radium behave unquestionably as homogeneous, though for zinc there is evidence of a heterogeneous secondary radiation which is not in equilibrium with the primary until $T = 2.5$ cm. It has always seemed to me that the significance of these results have been overlooked by later investigators.

Regener⁴ has given the result of an analysis of the absorption curve of cosmical rays "assuming incidence of the rays from all directions and taking the scattered radiation into account (cf. H. Kulenkampff, *Phys. Z.*, 30, 561; 1929)" but in the latter paper I have

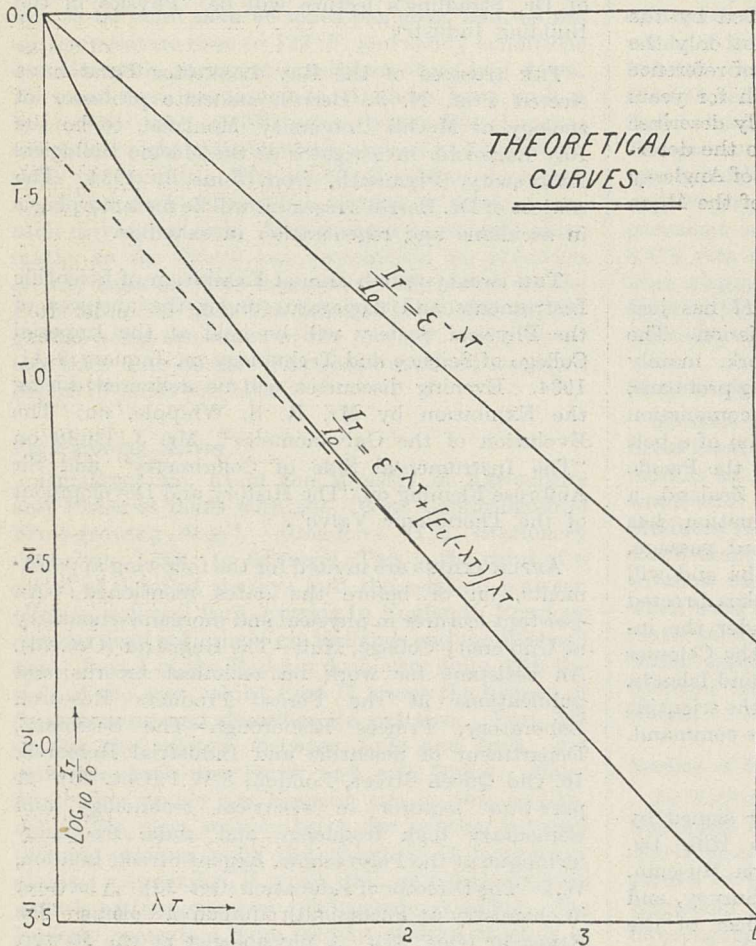


FIG. 1.

pretation of the Atom"—in which the original method of Millikan and other workers was rather thoughtlessly followed—and I have not been able to find an explicit anticipation of his correction. The point is that if a homogeneous radiation comes indifferently from all directions in half-space, the form of the absorption curve is not exponential, but such as to suggest heterogeneity of the rays. Mr. Booth did not suggest that the cosmical radiation was homogeneous, rather that if it were the absorption curve would not be exponential but of another form which he had worked out.

It is curious I should have overlooked this, as exactly this point—whether the departure of the absorption curve from the exponential form was due to obliquity or heterogeneity—I investigated with

been unable to find anything so intelligible as geometry. It would be interesting to know whether the exponential or the correct formula of absorption was applied.

FREDERICK SODDY.

131 Banbury Road,
Oxford.

- ¹"The Question of the Homogeneity of the γ -Rays. Part II. Absorption in Truncated Hemispheres." F. and W. M. Soddy, *Phil. Mag.*, vi, 13, 733-1910.
- ²J. W. L. Glaisher, *Phil. Trans.*, 160, 367; 1870.
- ³"Über Reflexion und Absorption von β -Strahlen." H. Willy Schmidt, *Ann. Phys.*, 23, 689; 1907.
- ⁴"Spectrum of Cosmic Rays." E. Regener, *NATURE*, 127, 233, Feb. 14, 1931.

If homogeneous radiation of unit intensity and of a kind that is absorbed exponentially is incident on the surface of water at a constant angle θ to the vertical, the intensity at a depth T is given by a formula of the type

$$I_{\theta T} = e^{-\lambda T / \cos \theta}$$

If, however, the radiation, instead of being in one direction only, is arriving from all directions in half-

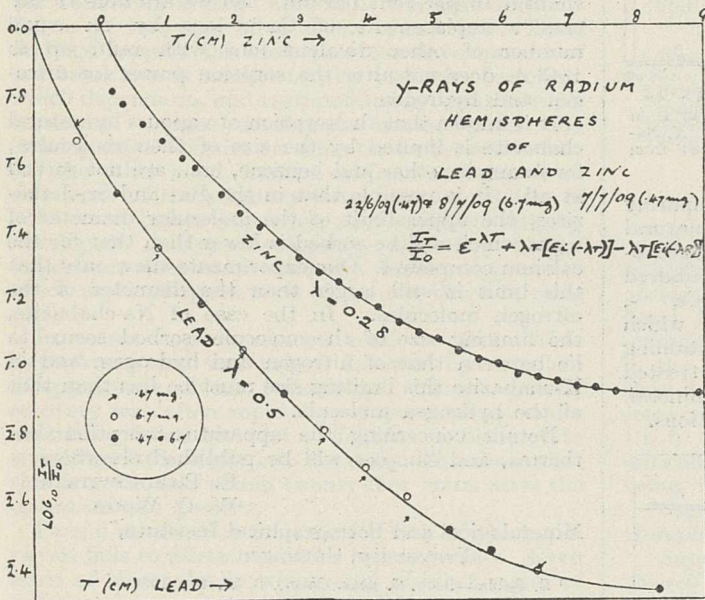


FIG. 2.

space indifferently, then the fraction of the total radiation that is inclined at angles between θ and $\theta + d\theta$ to the vertical is

$$\frac{2\pi R^2 \sin \theta d\theta}{2\pi R^2} = \sin \theta d\theta$$

The contribution to the total intensity at a depth T made by this part of the total incident radiation is

$$dI_T = e^{-\lambda T / \cos \theta} \cdot \sin \theta d\theta$$

Therefore the total intensity at a depth T is

$$I_T = \int_0^{\pi/2} e^{-\lambda T / \cos \theta} \cdot \sin \theta d\theta$$

By putting $y = \lambda T / \cos \theta$ and then integrating by parts, this expression can be transformed into

$$I_T = e^{-\lambda T} + \lambda T \int_{\infty}^{\lambda T} \frac{e^{-y}}{y} dy$$

Then, on putting $u = -y$ we get

$$I_T = e^{-\lambda T} + \lambda T \int_{-\infty}^{-\lambda T} \frac{e^u}{u} du$$

which may be written, using the ordinary notation for the exponential integral,

$$I_T = e^{-\lambda T} + \lambda T \{Ei(-\lambda T)\}.$$

The numerical values of the exponential integral corresponding to various values of λT can be found by referring to a suitable book of mathematical tables.

HARRIS BOOTH.

Atomic Transmutation and the Temperatures of Stars

THE letter of Gamow and Landau¹ suggests that an upper limit to the internal temperature of a star can be obtained by considering the disintegration of lithium. Investigations of this kind will probably be of great importance in the future development of astrophysics, but the actual proposal of Gamow and Landau rests on an assumption which is scarcely likely to be true. They postulate that any lithium found at the surface must have been carried there by diffusion from the central region, where it is presumed to have been created. Diffusion in a star is an exceedingly slow process, the time of relaxation being of the order 10^{13} years². It would make small progress during the maximum age of the giant stars. But there is a process of mixing which is likely to operate much faster, namely, the circulating currents in meridian planes indirectly caused by the rotation of the star. The order of magnitude is indicated in an example treated by the writer in which the speed of the vertical current was found to be 60 metres a year³. The example was chosen with the view of giving an upper limit to the amount of this circulation; but, allowing for slower currents in an average star, the lithium will be brought to the surface far more quickly in this way than by diffusion.

It is difficult to see how any consistent theory of distribution could be given if diffusion alone were operating. If there is time for lithium produced at the centre to reach the surface, there is time for the heavy elements to have disappeared from the surface by downward diffusion; or if it is supposed that they, like lithium, were created at the centre, there is no mechanism by which they could ever reach the surface. In the steady distribution towards which diffusion is slowly tending, there should not be a single atom of lead in the outer half of the volume of the star.

The existence of these circulating currents will raise the upper limits given by Gamow and Landau. Since the disintegration is sensitive to changes of temperature, the increase may not be very large; but it may well be sufficient to remove any difficulty in accepting the temperatures of the order $10^7 - 2 \times 10^7$ found by astronomical methods, whilst negating any suggestion of considerably higher temperatures.

A. S. EDDINGTON.

Observatory, Cambridge.

Oct. 9.

¹ *NATURE*, 132, 567, Oct. 7, 1933.

² "Internal Constitution of the Stars," § § 195-196.

³ *Monthly Notices R.A.S.*, 90, 54; 1929.

Ionic Exchange and Sorption of Gases by Chabazite

In experiments on the sorption of gases by zeolites, it has been shown¹ that, of seven samples of chabazite found in different localities, one showed a much smaller power of sorption than all the others. It was supposed that the cause of this peculiar behaviour of this one sample might be sought in its higher univalent ion (K^+ , Na^+) content, in contrast to the probable higher Ca^{++} -content of the other chabazites. We have therefore tried to find the relation between the power of sorption of chabazite

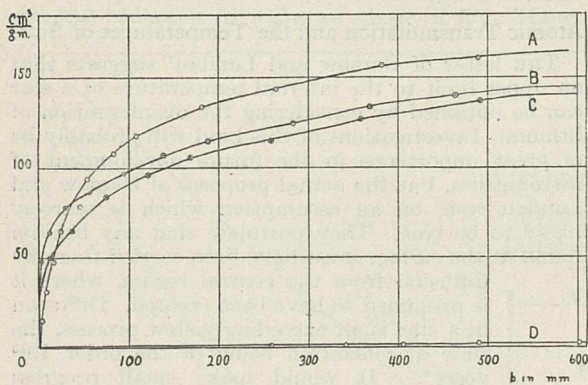


FIG. 1. Sorption isotherms of chabazite for hydrogen at $-190^{\circ}C.$ in c.c. per gm. dehydrated mineral (dehydrated at $500^{\circ}C.$). A, Na-chabazite; B, Ca-chabazite; C, Ca-chabazite reconverted from the K-chabazite; D, K-chabazite.

and its ionic content. This was done by comparing the sorption of different gases by samples of natural chabazite from Rübendörfel (near Aussig, Czechoslovakia) which had been boiled for two hundred hours in solutions containing K^+ , Na^+ , Ca^{++} , Sr^{++} , Ba^{++} , Cd^{++} , or La^{+++} -ions, in which way we hoped to obtain chabazites containing these ions. The sorbing power of samples so treated differed markedly from that of the original mineral, especially in the case of Na- and K-preparations.

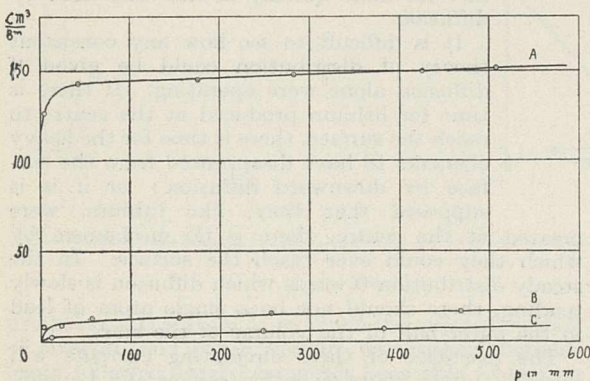


FIG. 2. Sorption isotherms of chabazite for nitrogen at $-190^{\circ}C.$ in c.c. per gm. dehydrated mineral (dehydrated at $500^{\circ}C.$). A, Ca-chabazite; B, Na-chabazite; C, K-chabazite.

Figs. 1 and 2 show the sorption isotherms for hydrogen and nitrogen at $-190^{\circ}C.$, for Ca-chabazite, Na-chabazite and K-chabazite. (The natural chabazite from Rübendörfel contains principally Ca^{++} -ions, and shows, too, a sorption nearly exactly equal to that of the Ca-chabazite.) From Figs. 1 and 2 it is obvious that the exchange of the calcium ions for sodium ions alters the sorptive power for hydrogen very little (slight increase), as contrasted

with the large decrease for nitrogen. The sorption of nitrogen by the K-chabazite is decreased still more than for the Na-chabazite; and this time, the sorption of hydrogen is practically zero.

That the change of sorptive power is reversible, is indicated by the fact that sorption curves of the Ca-chabazite, prepared by reconvertng the K-compound, are nearly identical with the original Ca-chabazite curves (Fig. 1).

These results show that the replacement of one Ca^{++} -ion ($r = 1.06$ A.) by two Na^+ -ions ($r = 0.98$ A.) decreases the sorption space of the crystals for nitrogen, but leaves it unaltered for hydrogen; further, the substitution of two K^+ -ions ($r = 1.33$ A.) for one Ca^{++} -ion appears to close up the sorption space in the crystal even for molecules so small as hydrogen. The experiments with the divalent ions Ca^{++} , Sr^{++} , Ba^{++} ($r = 1.06$ A. to $r = 1.43$ A.) show differences in sorption from that of the original mineral of not more than ± 10 per cent. (Only the Cd-chabazite showed a decrease of 30 per cent for hydrogen and 50 per cent for nitrogen.) That there really was an exchange of ions was shown by an analysis of the Ba-chabazite, which was found to contain 16 per cent barium. So we are able to say that a replacement of Ca^{++} -ions by an equal number of other divalent ions with radii up to 1.43 A. does not alter the sorption power for nitrogen and hydrogen.

It is known that the sorption of vapours by natural chabazite is limited by the size of their molecules; for example, ether and benzene, etc., are not sorbed at all. It is possible that in the Ba- and Sr-chabazites, the upper limit of the molecular diameter of a gas which will be sorbed is lower than that for the calcium compound. Our experiments show only that this limit is still larger than the diameter of the nitrogen molecules. In the case of Na-chabazite, the limiting size of the molecules sorbed seems to lie between that of nitrogen and hydrogen, and in K-chabazite this limiting size must be less than that of the hydrogen molecule.

Details concerning the apparatus, sorption isotherms, and samples will be published elsewhere.

E. RABINOWITSCH.

W. C. WOOD.

Mineralogical and Petrographical Institute,
University, Göttingen.

¹ E. Rabinowitsch, *Z. phys. Chem.*, B, 16, 43; 1932.

Tunny in the North Sea

AMONG the notes in the "Calendar of Nature Topics" in NATURE of July 15 are two paragraphs on the occurrence of tunny in the North Sea. This fish seems, indeed, to have become much more common there in recent times than it was some decades ago. A fisherman here, now concerned with Indian fishery investigations, recently told me that he remembers perfectly well that it was in the year 1911 (well-known also by an exceptionally heavy storm) that the big creatures, hitherto unknown, first came under the attention of those engaged in herring fishing on the North Sea. This particularly interested me, as 1911 was an exceptional year in its very warm and dry summer. My plankton investigations on the light-vessel *Haaks* off Den Helder, during the years 1910-1912, showed that the influence of this heat period was great also on the temperature of the sea and the development of the plankton. Diatoms, peridinians,

and copepods, one after the other, successively attained maxima several times higher than in normal years¹ and a southerly form like *Doliolum nationalis* pushed forward in great numbers to the latitude of Den Helder. Would it be possible that the tunny also in this remarkable year found its way into the North Sea and in subsequent summers has continued to frequent these northerly waters? It would be interesting to have further information upon the statement of my fisherman.

H. C. DELSMAN.

Laboratory for Marine Investigations,
Batavia.

¹ Delsman, De warme zomer van 1911 en het plankton by de "Haaks": Yaarboek Ryksinstituut voor het Onderzoek der Zee te Den Helder, 1911. Cf. also, *Bulletin Planktonique, Cons. Perm. Intern. pour l'Expl. de la Mer pour les années 1908-1911*, p. 114.

Sex Behaviour of Hypophysectomised Male Rats

STUDENTS of sex behaviour now agree¹, and we can confirm, that prepuberal castration prevents the development of sex behaviour. Recently we have found that gonadotropic hormones incite precocious sex behaviour in male rats while the same extracts fail to produce equivalent effects in castrates. These findings support the view that the development of sex behaviour is conditioned by testicular secretion, which depends on, and is stimulated by, gonadotropic hormones. Once developed, 'contractation' and 'mating drive'² persist for some time after castration. On the other hand, human subjects suffering from adenomas of the pituitary have experienced loss of *libido* even before impotence and testicular atrophy developed³. Hypophysectomy, according to an important observation made by Smith⁴, appears to effect rapid disappearance of the sex drive in male rats.

In recent experiments on rats, we found that hypophysectomy was indeed followed by complete disappearance of sex behaviour. Though general recovery was often rapid, hypophysectomised males invariably failed to react to females in heat, or to any other rat brought into the cage. This diserotisation is noticeable within twenty-four hours after the operation and persists.

Partial removal of the anterior lobe of the hypophysis fails to affect behaviour in many cases. Even some of the males in which only about 2 mgm. of anterior lobe substance were found at autopsy behaved normally, though no ejaculate was formed in some instances. In the majority of males in which partial extirpation was performed (weight of remaining gland substance 2-6 mgm.) an effect intermediate between persistence and complete extinction of sex drive was noted.

In the normal male, sexual activity consists in the successive performance of several acts such as pursuit, licking, mounting, clasping, palpation of the flanks, intromission and so on⁵. These acts are performed with greater or lesser vigour and more or less frequently. In the cases of partial hypophysectomy under discussion, the sequence of sexual acts was incomplete, the intensity of the contractation drive being manifestly reduced in some cases, but apparently unimpaired in others. Thus an experimental male would pursue a female and elicit the halting reflex. Then, instead of performing the complete sequence of copulation, it would make abortive attempts at mounting, hesitate and then desist quickly without palpation or even proper

clasping. Erection was sometimes observed in these abortive acts, which might be repeated for a long time or else abandoned after a few attempts. With very few exceptions this partial desexualisation was permanent.

Neither complete diserotisation nor partial extinction of sex behaviour could be reproduced by control operations. We are inclined to interpret these observations by assuming the existence of a pituitary secretion conditioning the persistence of sex drive and copulatory potency. Since castration does not produce desexualisation nearly so rapidly as hypophysectomy, it would seem that the hypothetic secretion of the pituitary does not become effective via the gonad.

These conclusions are being tested experimentally. In some instances certain gonadotropic extracts have restored mating behaviour, and it is hoped that these experiments will elucidate the nature of the erogenic function of the pituitary.

B. P. WIESNER.
N. M. SHEARD.

Macaulay Laboratory,
Institute of Animal Genetics,
The University, Edinburgh.
Sept. 19.

¹ Stone, C. P., In "Sex and Internal Secretions", London, 1932, p. 828.

² Nissen, N. W., *Genetic Psychol. Monogr.*, 5, 451; 1929.

³ Henderson, W. R., *Endocrinology*, 15, 2, 111; 1931.

⁴ Smith, P. E., *Amer. J. Anat.*, 45, 205; 1930.

⁵ Stone, C. P., *Amer. J. Physiol.*, 68, 407; 1924.

Investigations on Aquatic Fungi

At the recent meeting of the British Association at Leicester, some interest was shown by the members of Section K (Botany) in the occurrence of aquatic fungi in Great Britain. Since September 1932 investigations on these fungi have been in progress in the Department of Botany at the University of Bristol. It has been found that a number of species, some new to Great Britain, occur quite commonly. Up to the present, the following species have been critically studied, those marked with an asterisk being, it is believed, new British records:

**Saprolegnia dioica* de Bary (= *S. dictina* Humphrey).

Saprolegnia ferax (Gruithuisen), Thuret (= *S. Thureti* de Bary).

**Saprolegnia mixta* de Bary.

**Saprolegnia monoica* Pringsheim.

**Saprolegnia monoica* var. *glomerata* Tiesenhäusen.

**Achlya colorata* Pringsheim.

**Achlya americana* Humphrey.

**Achlya Orion* Coker and Couch.

**Achlya Klebsiana* Pieters.

**Achlya caroliniana* Coker.

**Achlya megasperma* Humphrey.

Achlya apiculata de Bary.

**Achlya apiculata* var. *prolifera* Coker and Couch.

**Achlya oblongata* de Bary.

Achlya polyandra Hildebrand.

**Achlya radiosa* Maurizio (= *A. decorata* Petersen; *A. asterophora* von Minden).

**Achlya de Baryana* Humphrey (= *A. polyandra* de Bary).

**Achlya recurva* Cornu.

Dictyuchus monosporus Leitgeb.

**Calyptralegnia achlyoides* Coker and Couch.

**Brevilegnia dictina* Harvey.

Pythiomorpha gonapodioides Petersen.

Leptomitius lacteus (Roth.) Agardh.

**Rhipidium europæum* von Minden.

**Rhipidium americanum* Humphrey.

Blastocladia Pringsheimii Reinsch.

Further investigations are in progress and it is hoped before long to publish a full account of the work which has been done.

W. R. IVIMEY-COOK.

University College of South Wales
and Monmouthshire.

E. J. FORBES.

University of Bristol.
Sept. 16.

Diagnosis of a Nervous Disease by Sound Tracks

SPEECH registrations have been used for many years in diagnosing nervous diseases at the West End Hospital for Nervous Diseases, London. Quite

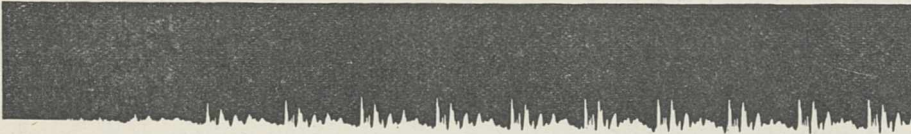


FIG. 1.



FIG. 2.

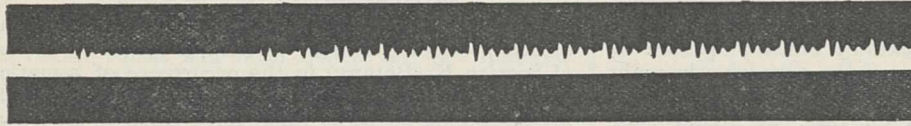


FIG. 3.

recently the method of registration on sound films has been introduced¹. Fig. 1 is the sound track of the vowel *ah* made at a film studio from a normal voice. It shows the vowel *ah* to consist of a series of short portions each of which begins with a sharp upward jerk. The upward jerk is the result of a jet of air from the glottis. The distance from one upward jerk to the next gives the period of the laryngeal action. The period changes slowly and never suddenly. This means that the muscles controlling the tension for the laryngeal action are well co-ordinated. Such a condition is known as *eutaxia*.

Figs. 2 and 3 are sound tracks of the vowel *ah* registered by patients known to be cases of disseminated sclerosis. The upward jerks follow one another at irregular intervals. The first one stands alone, far in advance of the others. The intervals for the following ones vary from long to short. This indicates that the muscles governing the laryngeal action were

shaky in their co-ordination. The condition is known as *ataxia*. The irregularity of the intervals is a registration of laryngeal ataxia. No abnormality could be observed by the ear in the speech of these patients. The film track test is thus ultra-acoustic.

Registrations of speech by the macrophonic—or graphic—method² in several hundreds of cases of disseminated sclerosis have shown that the ataxic waves are never absent. They are present also in other diseases that produce laryngeal ataxia, such as Friedreich's ataxia, cerebellar tumour, etc. These troubles are, however, never confused clinically with disseminated sclerosis.

The use of sound tracks for diagnosis is not impracticable. At present the patient must be taken to a film studio. The making of a registration requires only a few minutes. The film is ready for delivery on the following day. The Stoll studios at Cricklewood were generous enough to charge for the cost of the film only. It would be quite feasible to arrange for recording over the telephone system from a hospital to a studio.

F. JANVRIN.

73 Welbeck Street,
London, W.1.

¹ Janvrin and Worster-Drought, "Diagnosis of Disseminated Sclerosis by Graphic Registration and Film Tracks", *Lancet*, p. 1384; Dec. 24, 1932.

² NATURE, 132, 138, July 22, 1933.

Biological Effects of Abnormal Weather

WITH reference to Prof. Orton's letter in NATURE of September 9, a recent experience of my own may be interesting. Working at the Marine Laboratory at Lough Ine, County Cork, this summer I had occasion to use the common *Sabella pavonina* for

regeneration experiments. Specimens were collected by Prof. Renouf and myself from a locality at Baltimore where many of the worms are exposed at low spring-tides. With the worms collected late in July, practically all the fragments isolated for experiments died within a few days. A visit at the next spring-tide a fortnight later revealed the fact that a number of the worms, both those which were submerged and even some of those which were out of the water, had their tentacles protruded from their tubes, and many of these showed very sluggish reactions on being touched. On this occasion, too, there was a great mortality among the operated pieces, in strong contrast to the excellent viability reported by Berrill¹ and found by myself in June in specimens sent to London from Plymouth.

Some specimens, however, at this and at the next spring-tide appeared to be normal in their reactions,

and these gave fairly good results under experimental conditions.

The obvious explanation would appear to be that these animals had been affected by the extremely hot weather, which was unusual for the locality. If this is so, then we have an interesting example of a species being subjected, but at very considerable intervals only, to highly unfavourable conditions of temperature. This presumably would result in a high degree of selection for temperature resistance, but the length of the intervals between the times of stress would allow the selection to be largely negated by crossing and recombination.

It would be of considerable interest to know whether similar effects of the abnormally hot weather on littoral animals have been noticed elsewhere this season.

JULIAN S. HUXLEY.

King's College,
Strand. W.C.2.

¹ *J. Exp. Zool.*, 58, 495-523.

Selenium Dehydrogenation of Sitosterol

WE have reported¹ that the selenium dehydrogenation of cholesterol $C_{27}H_{46}O$ and ergosterol $C_{28}H_{44}O$ gives two different hydrocarbons, $C_{25}H_{24}$, m.p. 225° , and $C_{26}H_{26}$, m.p. 214° , respectively, while Diels and Karstens² claimed the formation of only one product, $C_{25}H_{24}$, m.p. 220° , from both sterols. Diels now suggests³, without new experimental work, that our hydrocarbons might be impure and insists on their identity. Cook and Hewett⁴ also think the diversity of the two hydrocarbons improbable and assign to them the formula $C_{25}H_{22}$ proposed by Rosenheim and King⁵.

We have found in the meantime that the X-ray spectra of our two hydrocarbons are distinctly different and that there is another argument for their diversity. If the two hydrocarbons were identical, sitosterol $C_{29}H_{50}O$ would furnish by the selenium dehydrogenation the same hydrocarbon. We obtained, however, by the latter reaction a new hydrocarbon melting at 202° - 203° (found C 91.9, H 8.0; calculated for $C_{27}H_{28}$, C 92.0, H 8.0); melting point of the compound with dinitro-anthrachinone, 246° - 247° . We do not believe, therefore, that any doubt can exist about the correctness of our formulation of the described dehydrogenation products. The detailed results will appear in the *Acta Helvetica*.

L. RUZICKA.
M. W. GOLDBERG.
G. THOMANN.
E. BRANDENBERGER.

Technical High School,
Zurich.
Sept. 22.

¹ *Acta Helv.*, 16, 812; 1933.

² *Annalen*, 478, 135; 1930.

³ *Ber.*, 66, 1124; 1933.

⁴ *J. Chem. Soc.*, 1098; 1933.

⁵ *Chem. and Ind.*, 52, 301; 1933.

Addition of Hydrogen Bromide to Olefinic Acids

IN a recent study¹ of the action of hydrogen bromide on a number of simple Δ^2 - and Δ^3 -olefinic acids, it was shown that the direction of addition was profoundly influenced by the nature of the solvent and it was suggested that in hydrocarbon solvents the carboxyl group controlled the orientation of addition whereas in acetic acid or in the absence of

solvent the double bond behaved independently of this group. After the completion of this work, Kharasch² published his remarkable discovery that the direction of addition of hydrogen bromide to allyl and vinyl bromides was controlled mainly by the peroxide content of the material. In view of this it was considered desirable to determine to what extent the presence of peroxides could influence addition to the simple olefinic acids. Experiments for this purpose are in hand.

J. C. Smith³ has now reported that the direction of the addition of hydrogen bromide to undecylenic acid in ligroin, which normally is such as to yield the terminal bromo-acid, is substantially reversed in the presence of hydrogen, or diphenylamine. In view of this interesting extension of Kharasch's work we think it desirable to state that experiments with allyl acetic acid indicate that the peroxide effect is here of secondary importance. Addition to the acid in hexane normally yields pure δ -bromo-valeric acid and we have been unable to reverse this in the presence of hydrogen, diphenylamine or hydroquinone. Moreover, both the freshly prepared acid and a very stale sample which yielded a strong peroxide reaction gave γ -bromo-valeric acid in the absence of solvent. A reversal of the addition to the acid in the absence of solvent can, however, be induced by the addition of benzoyl peroxide, which leads to the production of δ -bromo-acid. In this respect allyl acetic acid recalls the behaviour of propylene².

It thus appears that the importance of the peroxide effect varies with different unsaturated acids and that it cannot account for the influence of the solvent on the addition of hydrogen bromide to allyl acetic acid.

R. P. LINSTEAD.
H. N. RYDON.

Imperial College of Science,
South Kensington.
Sept. 30.

¹ Boorman, Linstead and Rydon, *J. Chem. Soc.*, 568; 1933.

² Kharasch and Mayo, *J. Amer. Chem. Soc.*, 55, 2468; 1933. Kharasch, McNab and Mayo, *ibid.*, 2521, 2531.

³ J. C. Smith, *NATURE*, 132, 447, Sept. 16, 1933.

The "Leeds Portrait" of Joseph Priestley

IN a communication in *NATURE* of June 17, p. 876, by one of us (W. C. W.), a reproduction of the earliest known portrait of Joseph Priestley appeared for the first time and with it a request for information regarding the present whereabouts of the original. This appeal failed to produce any replies, but extensive private inquiries in which we were jointly engaged have recently proved successful. We are unable to divulge the address of the owner of the portrait, but we have permission to state that it is in a private collection of family portraits in the possession of a grand-daughter of Mrs. Bilbrough (née Ellen Priestley) now living in Cheshire.

The owner has agreed to confidential notification being made to the secretaries of the Royal Society and to the Trustees of the National Portrait Gallery of the fact that the picture is in her possession.

Some details of its history, too long to be given here, will be published elsewhere.

DOUGLAS MCKIE.
W. CAMERON WALKER.

Department of the History of Science,
University College, London.

Research Items

Lunar Cult in India. Mr. V. R. Ramachandra Dikshitar contributes to the *Indian Antiquary* for September a note on the lunar cult in India in reference to a statement made by Prof. G. Tucci that "it does not appear that the moon was ever raised to the rank of an independent divinity or that it ever had its own temples and its own devotees". The lunar cult was, in fact, as old as the solar cult, and enjoyed an independent status like any other deity in the Vedic pantheon. If the evidence of the Yajur-veda-samhitā teaches anything, it is that the moon is raised to the dignity of a sacrificial god and is undoubtedly a Vedic deity; and in the Brāhmaṇa literature it is looked upon as an independent deity. The moon is a presiding deity in the sacrificial literature. The Purāṇas make elaborate reference to the different aspects of the lunar cult. The moon is one of the guardian deities of the directions. It is lord of the twenty-seven *nakṣatras* and one of the nine planets which go by the name of *navagrahas*. It is lord of the oceans and plants. The Tamil literature corroborates these statements. In the epic of Ilaṅko-Adigal the moon is one of six deities mentioned, among the others being the sun, the world and the rains; while an epic of the second century opens with an invocation to the moon god. There is an unmistakable reference to a temple of the moon which existed in ancient Puhār. Though the temples have disappeared, the worship continues. It was a custom of the ancient Tamils, which is still followed, to watch the moon rising on the second day after the new moon day, an act which is religious in character and tantamount to worship of the moon. To this day the moon is worshipped as a planet and as lord of the vegetable kingdom.

The Sanpoil and Nespelem of North-eastern Washington. A study of the Sanpoil and Nespelem, Salishan peoples of north-eastern Washington, U.S.A., by Mr. Verne F. Ray, based upon information collected on several visits to the territory of these tribes on the Columbia River between 1928 and 1930, has been published by the University of Washington (*Publications in Anthropology*, vol. 5. Seattle, 1932). The tribes are located in autonomous villages, but possess a certain cultural unity. They speak a dialect of Interior Salish. Of all the Plateau peoples they were the least affected by direct influence from other areas; and they possess no typically foreign culture traits. Their country was mainly treeless desert and subject to great ranges of temperature. All their villages were located along the river. The two dominant concepts in their culture were pacifism and the equality of men. Pacifism was carried to such lengths that heinous offences by raiding parties were allowed to go unrevenged. This concept applied not only to foreign relations, but also was operative, to an even greater degree, in the daily life of the people. It was one of the principal duties of the chief to see that the peaceful life of the community was not disturbed. Family trouble was unheard of. This was in part due to the fact that if anyone was dissatisfied, it was his privilege to leave and make his home elsewhere. There were no class distinctions and when a new chief had to be elected, anyone was eligible. The chief remained one of the people and was as accessible as any man in the group, his

powers being advisory rather than dictatorial. It is to be noted that these tribes, living in the centre of the plateau, which have been regarded as a cultural mixture of north-west coast and plains traits, in these two characters exhibit a direct contrast to the rigid class system of the coast, and the plains ideal of the exhibition of bravery in warfare.

Fresh- and Brackish-Water Copepods of North America. Dr. C. Dwight Marsh, custodian of fresh-water copepods, Division of Marine Invertebrates, United States National Museum, who died just one month after this paper was submitted for publication, in this his last work "Synopsis of the Calanoid Crustaceans, exclusive of the Diaptomidæ, found in Fresh and Brackish Water chiefly in North America" (*Proc. of the United States Nat. Mus.*, 82) covers the forms of North America and in addition discusses certain species not limited to those of that continent, and, in some cases, includes those of the world. It is a purely systematic and most useful contribution to copepod literature, including four families: the *Centropagidæ* with two genera, the *Temoridae* with three and the *Pseudodiaptomidæ* with two. To these well-known families the author adds a new one, the *Senecellidæ* with one genus only—*Senecella*. A good key to the genera of fresh-water and brackish-water Calanoida is given and also keys to the species of each genus, the descriptions and discussions are detailed and there are twenty-four plates of careful outline drawings. Besides a good list of literature cited there is also included at the end of the paper a complete bibliography of papers on copepods by Dr. Dwight Marsh, who was a leading authority on this group of Crustacea. The list was compiled by Miss Lucile McCain and comprises 35 titles of papers published over a period of forty-three years.

Storage of Walnuts. Most people know how annoying it is to break open a walnut, only to find the kernel quite black or mouldy. This state of affairs can be prevented if the nuts are stored in suitable media ("Some Recent Investigations into Methods of Storing Walnuts during the Winter" by Miss Joyce B. Hammond; *Gardeners' Chronicle*, Sept. 16, pp. 219-220). Methods for the speedy and complete removal of the green outer husk are described. This prevents the growth of fungi, which find the husk a very suitable medium for growth and then penetrate the shell through the suture. Bleaching may be practised and the nuts should be stored either in a cool store (about 38° F.) or in a suitable storage medium at a higher temperature (about 45° F.). A mixture of coco-nut fibre and salt was found to be the best storage medium. The salt acted as a fungicide, whilst the fibre prevented the accumulation of too much moisture.

Geology of British Somaliland. Under this title, Part I of a valuable memoir by W. A. Macfadyen on a hitherto little-known region has been published by the Government of the Somaliland Protectorate (pp. 87+4 plates and map in folder. London: Crown Agents for the Colonies. 12s. 6d. net). After dealing with the earlier investigations, the physiography of the plateau, of the lower country to the north known as the Guban, and of the drainage system is reviewed.

The geological formations described embrace Recent and Pleistocene deposits and raised beaches; the Aden volcanic series and various sedimentary strata of Miocene, Oligocene, Eocene, Cretaceous, Jurassic and doubtfully Triassic ages. These rest on a crystalline basement of igneous and metamorphic rocks referred to the Archæan. The structure of Somaliland is almost entirely determined by simple faulting, of which there are three main trends: (a) the Gulf of Aden, east-north-east; (b) the Red Sea, north-west; and (c) the East African, north. Faulting appears to have occurred at two main periods, late Eocene to Oligocene, this being the more important, and late Pliocene. Some of the faults are of extraordinary throw, that of the Dagah Shabell fault being between 4 km. and 6 km. One of the Red Sea faults has a throw of more than 3 km. Folding is rare and no simply folded ranges are known. The memoir contains a good bibliography, notes on water supply, a list of fossil localities, a series of 42 strata sections and a petrological contribution from Dr. A. Harker on the igneous and metamorphic rocks. Fossil collections are now being worked out and will be published later as Part 2.

Structure of Metallic Films. Two papers have been published (*Proc. Roy. Soc.*, August) on the study of the structure of metallic films by the electron diffraction camera. Finch and Quarrell have designed an apparatus in which a film is formed by deposition of evaporated metal and immediately examined by electron diffraction without removal from the vacuum. Films of magnesium, zinc and aluminium were formed. The vapours in transit between source and receiver showed no diffraction patterns and were apparently atomic. The films deposited on sputtered platinum surfaces showed crystal structure which was the normal structure, characteristic of the metal, when the films were thick. In thin films the structure was distorted by that of the underlying platinum. The crystals were not oriented on deposition on cold surfaces but showed orientation when the receiving surface was heated. Finch, Murison, Stuart and G. P. Thomson have formed platinum films by sputtering under different conditions, and have examined their catalytic activity on electrolytic gas. Films deposited by slow sputtering in oxygen and transferred to electrolytic gas showed a period of induction before catalysing the combination. Such films showed in the electron diffraction camera patterns apparently due to PtO_2 . They blackened on exposure to electrolytic gas or hydrogen, but could not be examined by electron diffraction in this blackened, catalytically active condition as they became inactive on drying. Films sputtered in argon and nitrogen were either immediately active or quite inactive—they showed diffraction rings characteristic of platinum. Similar films were obtained by sputtering in oxygen at the heavier currents (see also *NATURE*, 131, 842, 877; 1933).

Raman Spectra. The *Bulletin de la Société Chimique de France* (June) contains a detailed survey of the theory and practice of the Raman spectrum method, as applied to chemistry, which is both intelligible and suggestive. The physical aspects of the matter are dealt with by Volkringer and the chemical by Bourguet. The great mass of experimental results which has accumulated within the last two or three years is critically considered, and sufficient numerical

data given to make the quantitative relations plain. The underlying theory and the conclusions drawn from the results as to the chemical linkages in the types of compounds studied are both very clearly set out. The description of the experimental methods is sufficiently detailed to be of great value to those who propose to work with Raman spectra.

Protection of Iron in Sea-Water by a Nitride Film. Since 1928, when R. May employed the movement of the 'film-potential' to demonstrate the self-healing qualities of the oxide film on aluminium brass, the principle has been adopted and extended by many investigators. In general, if the film on any metal breaks down when the metal is introduced into a liquid, the electrode-potential collapses towards that of film-free metal, whilst if the film has self-healing properties, the potential tends to rise. A new and interesting example has been described by Mr. S. Satoh, of the Mitsubishi Research Laboratory, Tokyo, in a communication addressed to the Editor. A steel containing 11.72 per cent of manganese, when introduced into sea-water, showed a *falling* potential, which finally became constant after 50 hours at -0.83 volts, and the metal suffered considerable corrosion; the same steel, previously covered with a nitride film, showed a *rising* potential, the value reached after 350 hours being $+0.06$ volts; in this case, the metal suffered absolutely no rusting. Certain other ferrous materials seem to display slight increase in resistance to corrosion when covered with a nitride film, and this improvement is reflected in a change in the time-potential curves; but the difference produced by the nitride coat is less impressive than in the case of the high-manganese steel.

Effect of Tin on Mild Steel. A paper read by Prof. J. H. Andrew and Mr. J. B. Peile before the Iron and Steel Institute at its recent meeting in Sheffield considered the effects of small quantities of tin upon the mechanical properties of mild steel. The matter is of importance, since the cheapest scrap which can be used in the manufacture of mild steel entails the risk of the contamination of the metal by tin as an impurity. It is shown that with a tin content up to a maximum of 0.6 per cent the tensile properties of the steel, including the ductility, are not impaired, the yield point and the maximum stress being in fact slightly increased. On the other hand, if the amount of tin exceeds, at the most, 0.2 per cent, the impact value in the normalised condition is greatly reduced. In the heat-treated state this embrittlement to notched-bar tests occurs at still lower tin contents. The effect is much more detrimental if the steels are tempered at a low temperature after quenching, and if they are allowed to cool slowly through the temperature range from 400° to 200° C. after tempering. The ill effect of tin upon the impact strength of these steels is minimised by quenching after a full tempering at about 620° C. These effects bear a similarity to the 'temper-brittleness' to be found in certain nickel-chrome steels. There is indirect evidence that the embrittlement may be due to thin films of carbide which are formed at the grain boundaries. If this be so, it may indicate that tin is a more objectionable constituent of high carbon steels than of the lower carbon material which has been examined in this research. In an appendix, methods are described for the estimation of small amounts of tin in steel.

Progress in Aeronautics Research*

THE Aeronautical Research Committee's annual report for 1932-33 is the first to be issued over the name of the new chairman, Mr. H. T. Tizard. It commences with a well-deserved tribute to the retired chairman, Sir Richard Glazebrook, who had held that post since the inception of the Committee in 1920, and was also in charge of the preceding body, the Advisory Committee for Aeronautics, since 1909, a continuous period of twenty-four years' service.

The first part of the report deals with the situation in general. It justifiably claims that the fundamental researches of the various bodies advised by the Committee have helped towards Great Britain capturing the world's speed record (since lost to Italy), the long distance non-stop record (now beaten by France), and the altitude record (also since lost to France).

Considerable progress has been made with equipment in the various laboratories. The new 24 ft. open jet wind tunnel at the Royal Aircraft Establishment, Farnborough, by Messrs. Boulton and Paul, is in an advanced stage of erection and is estimated to be running by April 1934. A new high speed 9 ft. by 7 ft. open jet tunnel is now completed at the National Physical Laboratory, Teddington, and has reached speeds up to 140 m.p.h. It is considered successful enough to warrant approval being given for another of similar design and dimensions. One of the Royal Aircraft Establishment's tunnels has been the subject of experiment upon increase of efficiency and wind speeds, which have been increased to 210 m.p.h. Progress has also been made by Mr. Relf in the equipment and technique of the manipulation of the compressed air tunnel at the National Physical Laboratory. The balance carrying the model is now installed and giving satisfaction. The forces, measured by an adaptation of the Kelvin current balance principle, can be determined to an accuracy of 1 per cent in the range 0.5-1,000 lb.

A new seaplane tank at the Royal Aircraft Establishment has been put into operation and is now being calibrated, particularly with regard to the effect of walls and depth of water on the models under test. It is proposed to commence investigation upon 'porpoising' shortly, a phenomenon which is giving world-wide trouble with sea-going aircraft.

The second part of the report, dealing with the work done in more detail, gives it principally as a précis of the Committee's publications upon the various subjects. In aerodynamics the investigations upon 'flutter' and 'buffeting' have been collected and collated and the broad problem is now understood. It seems probable that preventative measures so far effective may not be adequate with increasing speed. Tail buffeting, being caused by eddies forming the wake of the front parts of the aircraft, is susceptible to changes in such eddies, which may be set up by unexpected things such as the opening outwards of a cabin window, change in the flow of air through an engine radiator, etc. The position with regard to 'spinning' is similar. Existing knowledge has been clarified, which work has been helped by the vertical wind tunnel at the Royal Aircraft Establishment. The presence of wing slots may introduce unexpected complications in certain cases.

The study of performance has been facilitated by the development of a system of attaching wool tufts to parts of an aircraft and 'cinematographing' them during flight. A permanent record of the state of the air flow over that part, which can be studied at leisure in conjunction with mathematical and wind tunnel investigations upon the subject, is thus obtained. The problem of excess speed obtained by diving during high-speed flight has been worked out, and it is interesting to note that the speeds obtained in the high speed record flights were practically the maximum obtainable within the limit of diving allowed. The effects of interference have been further studied and results published in a monograph which summarises the position with regard to ideal shapes. Mutual interference between parts grouped on a machine, or necessarily of a non-ideal form, can best be studied by actual experiment with visual methods, such as the use of wool tufts.

The particular problem of the seaplane at present is 'porpoising'. The limited and somewhat crude data available have been used to draw up general rules for its control, and also to suggest lines of investigation in the new seaplane tank now coming into use at the Royal Aircraft Establishment. A novel method of modified full-scale tests has been used in these and similar problems. Large-scale models of proposed very large hulls have been attached to smaller machines, and flown with the necessary measuring apparatus attached.

The work on aircraft structures and materials has been principally that of investigating the behaviour of thin materials under high stress, in forms suitable for aircraft parts. This includes the action of thin sheet panels in continuation of work recently carried out in Germany and elsewhere. The torsional stiffness of wings can be increased by the correct design and positioning of wing ribs. This problem has been investigated at the Royal Aircraft Establishment, both from the point of view of individual wing stiffness and also its effect upon ailerons in maintaining lateral control.

The effects of welding upon the various materials most generally used for aircraft have been considered. Dangers due to inconsistency in strength of a part appear to be inevitable with certain work-hardening materials and the air-hardening steels, when welded. These can only be avoided by correct design and workmanship.

Aero-engine development has progressed principally along the lines of reduction of fuel consumption. The best results have been obtained from the use of automatic control of the fuel-air mixture, used in conjunction with an understanding of the most economical engine speed for any existing conditions. Limited experiments in flight carried out so far have resulted in a gain of 7 per cent in consumption.

Experiments on compression-ignition engines have confirmed the views already held by the Committee, that the two-stroke engine holds the greatest promise from the point of view of light weight competitively with the petrol engine. Successful flame traps, the general use of which has been considered to be satisfactory by the Accidents Sub-Committee, have been produced.

The investigations upon noise in aircraft have not made much positive progress. It has been established that airscrew noise is so proportionately large that until this can be greatly reduced, there is little gain in adding complications in order to silence the engine exhaust.

* Aeronautical Research Committee. Report for the Year 1932-33. Pp. iv+94+5 plates. (London: H.M. Stationery Office, 1933.) 2s. net.

Applications of Statistical Methods

SECTIONS A* (Mathematics) and J (Psychology) of the British Association held a joint discussion at Leicester on September 12 on "The Validity and Value of Methods of Correlation", which was opened by Prof. C. Spearman. One group of speakers dealt with statistical methods from a general point of view, with applications to a wide field, including medical and sociological aspects, while a second group restricted themselves to psychological applications, and in particular to Spearman's 'two-factor theory'. It will be simpler to separate these two groups here, although in the actual discussion they were mingled in a rather confusing manner.

Dr. S. Dawson (Glasgow) gave a warning against the misuse of statistical measures such as correlation coefficients, which, as he showed by an example, can be sometimes very misleading. The statistician must not be content with such short cuts, but must be prepared to look beyond his coefficient to the actual data themselves. Dr. Dawson illustrated how this could be done by a reference to an investigation into Glasgow housing conditions.

Dr. S. S. Wilks (Princeton) explained a new criterion for testing the mutual independence of several sets of traits. This criterion may be regarded as a generalisation of $1-R^2$, where R is the multiple correlation coefficient between one variate and several others. A full account of the subject will be found in a recent number of *Biometrika*.

Dr. J. O. Irwin (London) pointed out that there is a tendency for everyone to use coefficients of association, whether he understands them or not. It is desirable not to rely solely upon such a coefficient, but to express results in a form which gives a physical or concrete meaning; the more easily the result may be understood by an intelligent layman the better. Dr. Irwin then applied his principles to several examples, including an investigation into accident proneness at a naval shipyard, carried out for the Industrial Health Research Board. The results were illustrated graphically.

Prof. R. A. Fisher (Rothamsted and London) summed up the discussion of this group of speakers. He emphasised that no data can absolutely prove a hypothesis, but they can disprove it, and it is the function of the statistician to devise tests which shall indicate clearly when a hypothesis is to be rejected. For this purpose the statistician must know something about the quality of the experiments, and it is advisable for the experimenter to consult him before fixing the exact design of his experiments.

Before summarising the remarks of the second group of speakers, who dealt with Spearman's 'two-factor theory', it may be well to outline the main points of this theory. No such outline was given at the discussion; in recent years the theory has become very widely known, and hence the speakers considered themselves justified in dealing only with its more obscure parts.

It is an experimental fact that if a number of dissimilar mental tests are applied to a group of individuals, and the coefficients of correlation between these tests are measured, then these coefficients, taken in sets of four, furnish what are called tetrad differences, the numerical values of which are

approximately zero. From this is inferred, by somewhat difficult reasoning, that the marks obtained by an individual in any particular test are the sum of two parts, one proportional to his general factor g , and the other proportional to his specific factor s for that particular test. It is tempting, but venturesome, to identify g with general intelligence or general mental energy, while s may be identified with special ability for some particular task.

Prof. C. Spearman (London) mentioned that he had recently returned from a tour of the United States, where he attended a number of psychological meetings in various centres, collecting all the objections raised to the two-factor theory. He had tabulated these and indicated the appropriate reply in each case (a copy of this document was given to all present). He then dealt in detail with an objection raised by Prof. E. B. Wilson, that the value of g would be altered by what mathematicians call a linear transformation of the test scores. The reply is that this can only be done by introducing into each of the composite abilities negative elements exactly equal in influence to the positive ones, which is in flagrant contradiction to psychological experience.

A short but vigorous discussion followed. Dr. J. Wishart (Cambridge) pointed out that linear transformations of Wilson's type are never used by psychologists, so they need not worry over the difficulties that would be caused if they did use them.

Dr. W. Brown (Oxford and London) presented the results of an extensive research by Dr. W. Stephenson and himself, to test, with every precaution called for by the critics of previous investigations, the abilities of a large number of boys, all of nearly the same age, by means of nineteen carefully selected mental tests. The resulting tetrads were fitted to a smooth curve (exhibited on a large diagram at the meeting) and shown to conform closely with the distribution which is to be expected from random sampling if Spearman's theory is true.

Dr. Wishart dealt searchingly with the question of random sampling errors. He pointed out the great difficulties in deciding whether a distribution of tetrads, such as Dr. Brown's, does really agree with that to be expected from random sampling. Possibly some of the difficulties can be overcome by using a tetrad of product moments in place of that of correlation coefficients. Further work on these lines is in progress.

Prof. H. T. H. Piaggio (Nottingham) analysed the results of Dr. Brown and others by the aid of a formula giving g in terms of the test results, but also containing an indeterminate portion. To make this portion negligible we need tests with a greater g -saturation. The same formula can be used to discuss the transformations dealt with by Prof. Spearman.

The discussion concluded with forty minutes of rapid questions and answers, which cleared up many points, and perhaps was the most valuable part of the proceedings. The collaboration of workers in two branches of science is not yet so common as it should be, but it is gratifying to notice that it appears to be on the increase.

H. T. H. PLAGGIO.

Origin of the Celts

A PAPER on this subject was read on September 7 by Dr. J. Pokorný (Berlin-Halensee) before Section H (Anthropology) at the Leicester meeting of the British Association. He pointed out that people usually look for the Celtic cradle in south-west Germany and the Rhineland, where we find the greatest number of Celtic river names, like Rhine, Danube, Tsar, etc., and where later the historical Celtic La Tène culture originated from the western Hallstatt culture, which again is in many ways a continuation of the south German Tumulus culture of the late Bronze Age. This Tumulus culture, so called because the dead were buried under barrows, extended from Holland and middle France through South Germany as far as south-west Bohemia.

While northern Germany, between the Weser and the lower Oder, and southern Scandinavia were occupied by the yet undivided Teutons, the authors of the Nordic Bronze Age, eastern Germany as far as western Poland and Czechoslovakia was in the hands of the Urnfield people of the Lausitz culture, so called because they burned their dead and put them to rest in extensive fields of cinerary urns.

Of late, it has become evident that at about 1200 B.C. very important movements of peoples and cultures, only to be compared to the wanderings of peoples at the beginnings of the Middle Ages, transformed the cultural aspect of the greater part of Europe. The Urnfield people conquered in a strong westward movement all the lands of the Tumulus people, penetrating through southern France so far as Catalonia, at the same time conquering the whole Alpine territory, north-eastern Italy, the whole of Hungary, and penetrating so far as Macedonia. In the territories of the Tumulus people they became finally absorbed by them. In this way the Celts of history came into existence.

We are fortunately in a position to solve the question as to the ethnological origin of the Urnfield people. Their southward colonies spread chiefly in two directions; to Hungary, where we find in earliest times the Illyrians, and through the Alps to north-east Italy, where we find the closely related Venetians, the ancestors of the modern Albanians. If Slavonic peoples had been the authors of the Lausitz culture, we should find in the dawn of history Slavs in Dalmatia, Pannonia and Venetia instead of Illyrians and Venetians. A great number of Veneto-Illyrian

place and river names in the Lausitz territory point in the same direction: Tharandt in Saxony identical with Taranto in Italy, the river name Netee, older Natisus identical with the Venetian river Natiso, the name of the Slavonic Wends, taken over from the earlier Venetian inhabitants, etc. Dr. Pokorný traced for the first time a great many Veneto-Illyrian names in Celtic territory, like the Veneti in western Gaul, the Boii in Gaul and Bohemia, and many names containing Indo-European which could not be explained in Celtic, like the Pictavi and Menopii in Gaul, and many river names originally ending in -apa or -apia. He also indicated important points in phonetics, grammar and word building which showed the close relationship between Celtic and Veneto-Illyrian, and many close analogies between Celtic and Balto-Slavonic, which can only be explained by the fact that the Illyrians, whose eastern neighbours had been the Baltic and Slavonic peoples, formed the bridge between them.

But to what nation did the other element in Celtic, the Tumulus, belong? Considering the fact that by far the closest analogies to Celtic are found in the Italic languages, so that we may even speak of an original Italo-Celtic community, and that the first Aryan invaders of Italy (about 2000 B.C.) seem to have come from the same direction, from the northern slopes of the Alps near the upper Danube, the Tumulus people may be identified with the primitive Italo-Celts who remained in their old home after the Italic peoples left for the south. Their amalgamation with the Illyrian Urnfield folk produced the ancient Celtic nations, which are, of course, different from the modern Celt. The latter show in the whole structure of their language close affinity to the languages of the white Mediterranean peoples of northern Africa, who had brought megalithic culture to the British Isles, and in a strong degree absorbed the invading Celts.

The relations between Teutonic and Celtic languages were comparatively late; the apparent linguistic isolation of the former is easily explained by the fact that their southern and eastern frontiers were occupied by the Veneto-Illyrians, of whose language we know so very little.

Finally, Dr. Pokorný directed attention to the fact that most of the Aryan elements in the language of the so-called Ligurians are also probably due to an Illyrian invasion.

The 'Iconoscope' for Television

THE development of television on a practicable scale is being accelerated in many parts of the world by the application of the cathode ray tube. One of the most interesting of these applications is the 'iconoscope' described by Dr. V. K. Zworykin in a paper presented to the Institute of Radio Engineers at the Chicago Convention last June, an abstract of which appears in the July issue of the American Journal *Electronics*.

The iconoscope has several striking analogies to the human eye, with its retina of light-sensitive nerve cells. It consists of a cathode ray oscillograph tube in which the 'screen' is a plate covered by some three million small photoelectric cells, each con-

nected through a small capacity to the electrical output circuit. A lens, external to the tube, focuses on this plate an image of the scene to be televised. Whenever the light of a bright part of the image falls on one of these minute photoelectric cells, current from the cell charges up the small condenser associated with it. Over the screen the charge on the condensers varies according to the illumination of the image. A cathode ray beam is now employed to scan this plate in the usual manner. As this beam sweeps across a charged condenser, the charge is liberated and the discharge current passes to the output circuit where it is amplified and transmitted to the receiver.

At the receiving end, the incoming pulses are used to modulate another cathode ray beam which, scanning a fluorescent screen, re-creates the original picture. Each photoelectric cell is very small and so the individual currents and capacities are small. Thus the time required to charge and discharge these condensers is very short and pictures with as many as 250 lines to the inch are possible.

The iconoscope tubes are about 16 in. long, with a bulb 8 in. in diameter, enclosing a mica sheet of dimensions about 4 in. \times 5 in., which carries the three million independent photoelectric cell units. The sensitivity of the device, at present, is approximately equal to that of photographic film operating at the speed of a cinema camera. The tube opens up possibilities for applications in many fields as an 'electric eye', which is sensitive not only to the visible spectrum but also to the infra-red and ultra-violet regions.

University and Educational Intelligence

CAMBRIDGE.—The Benn W. Levy research studentship in biochemistry is vacant. Applications from candidates should be addressed to Sir Frederick Gowland Hopkins at the School of Biochemistry.

A grace has been proposed to accept the offer from the Empire Cotton Growing Corporation to continue for a further period of five years its grant of £1,000 a year to the School of Agriculture.

EDINBURGH.—On October 11, Prof. Ivan de Burgh Daly, who has succeeded Sir E. Sharpey Schafer in the chair of physiology, delivered his inaugural address on "Perspectives in Physiology", in which he examined some of the problems of organised teaching and organised research in the subject. Later he referred to the intimate relationship between physiologists in Edinburgh and at University College, London, which was initiated by the transfer in 1836 of William Sharpey from Edinburgh to University College and has been continued by the exchange of men between the two seats of learning until the present day.

On October 13, Prof. J. S. Haldane delivered to the Royal Medical Society (founded 1737) the inaugural address for the present session on "Vision of Brightness and Colour", in which he considered on what conditions brightness and colour depend, discussed coloured shadows, the blue of the sky and the sea and other colour phenomena, and criticised some of the theories of vision.

GLASGOW.—Miss Maggie Donald Rankin has given the sum of £20,000 for the purpose of medical research in connexion with the University. The managers of the fund are to give special consideration to the claims of cancer research, but are not restricted to this.

A bequest of £8,000 by Miss Bethia Aitken Gray is to constitute an endowment fund the income of which is to form a bursary in engineering, to enable the holder to study the evolution of this science by travel abroad and inspection of great engineering achievements from the earliest times to the present day. The interesting suggestion is made that Egypt will provide a suitable field for the bursar to commence his studies.

LONDON.—Dr. C. M. White, lecturer in civil engineering at King's College, has been appointed as from January 1, 1934, to the University readership in

civil engineering tenable at the Imperial College—City and Guilds College. Mr. Harry Berry, head of the Department of Pharmacy at the Central Technical College, Birmingham, has been appointed as from January 1, 1934, to the University readership in pharmaceuticals tenable at the College of the Pharmaceutical Society of Great Britain.

SHEFFIELD.—Prof. J. B. Leathes, until recently professor of physiology in the University, has been appointed emeritus professor. Mr. E. J. G. Bradford has been appointed lecturer in normal psychology in the Faculty of Medicine.

Mr. A. Graham, lecturer in zoology, and Dr. W. Vincent, lecturer in mental diseases, have resigned.

The Council has received a donation of £5,000 from Sir Robert Hadfield (see NATURE, Sept. 16, p. 440), and the late Mr. Bernard Hobson's collection of rocks, and microscopic slides with cabinets, from Mr. Wilfred Hobson.

THE "London University Guide" recently published by University Correspondence College, 32 Red Lion Square, London, W.C.1, presents in conveniently compact form a series of readily intelligible summaries of regulations relating to matriculation and the external examinations of the University of London, together with syllabuses and advice as to textbooks. The methods of instruction by the Correspondence College tutors, whose names and qualifications are specified, and the facilities provided for laboratory practice are fully described. Particulars are given of the special subjects prescribed for examinations of the University of London for 1934-35.

THE Council of the North East Coast Institution of Engineers and Shipbuilders has made the following awards of scholarships and grants: Institution scholarship, value £100 a year, to William Leslie Stewart (Sunderland Technical College); grant of £50, to John Campbell Matthew (Sunderland Technical College); George Mitchell Harroway scholarship, value £100 a year, to Guy Gowland Harforth, to enable him to study at Armstrong College for the degree of B.Sc. in naval architecture. The scholarships of Mr. E. J. C. Statham (1931 scholar) and Mr. John Cecil Brown (1932 scholar) have been continued for a further year. The total value of the above scholarships and grants awarded by the Institution is £450.

THE Institution of Electrical Engineers has awarded the following scholarships for 1933, the value and tenure of each of which is given in brackets: Duddell scholarship (£150, three years), H. Haywood (Staveley Grammar School); Silvanus Thompson scholarship (£100, plus tuition fees, two years), P. L. Olsen (Messrs. C. A. Parsons and Co., Ltd.); Swan Memorial scholarship (£120, one year), D. A. Bell (Magdalen College, Oxford); David Hughes scholarship (£100, one year), R. C. Barton (University College, Cardiff); Salomons scholarship (£100, one year), R. S. Quick (University of Bristol); War Thanksgiving Education and Research Fund (No. 1) (£50 grant), R. G. Armstrong (University College, London), (£50 grant) D. H. R. Whyman (University of Sheffield); Paul scholarship (£50, two years), R. P. Kinsey (Wandsworth Technical Institute); Thorrowgood scholarship (£25, two years), L. F. Tuff (London and North Eastern Railway). No award of the Ferranti scholarship was made.

Calendar of Nature Topics

Red Squirrel

At this time of the year, the nut-feeding of the two English squirrels, red and grey, makes the rodents more noticeable than is perhaps usual at other times. The red or brown squirrel of England (*Sciurus leucorouus*, Kerr) is subject to similar cycles of disease as the voles and other rodents, and evidence seems to show that this, and not the increase of the alien grey squirrel (*Sciurus carolinensis*, Gmelin), is the cause of the scarcity of brown squirrels in many places, especially where grey squirrels do not normally occur, as Lancashire (Middleton, *Proc. Zoo. Soc. London*, October 1930); a great decrease of red squirrels occurred in 1904-14. Harvie Brown (*Proc. Roy. Phys. Soc.*, 1880-1881) described the earliest date it was recorded in Scotland as 1630, in Sutherland, and that if it was ever indigenous to south Scotland, it must have disappeared at a very early period, but since 1772, when specimens were released in Dalkeith Park, it became very widespread. The winter sleep of the red squirrel has often been described as but a light one, and specimens are often abroad in heavy frost. The autumn nut-gathering also sees a breaking up of the breeding territories formed in spring and summer (Eric Hardy, "Habits of Red Squirrel at Liverpool", *Naturalist*, March 1933) and an increased greyness in the coat. Millais has recorded a black specimen at Watford, 1865, and many albinos are on record.

Grey Squirrel

The seasonal change in the coat of the grey squirrel (*Sciurus carolinensis*) with the speckling of silver-grey on the sides of the neck, flanks and hind quarters is becoming noticeable. Head and back, however, are covered by a broad band of drab brown, which has led to confusion in cases with the red squirrel, though the absence of ear-tufts in the grey is distinctive.

The first liberation of grey squirrels in Great Britain is uncertain; the earliest date on record is that of the release of two specimens by T. U. Brocklehurst at Henbury Park, Cheshire, in 1876, but a specimen described as a grey squirrel in detail was shot near Llandisilio Hall, Denbighshire, October 1828, and others were stated to exist in parts of Montgomeryshire and Denbighshire (*Cambrian Quarterly Mag.*, 2, 351; 1830). This description does not indicate any confusion with the red squirrel in winter coat. Afterwards there were some thirty-three centres of introduction of grey squirrels into the British Isles between 1889 and 1930, and there is reason to believe the species may cover the whole country with the possible exception of mountainous districts as in northern Scotland.

During 1931 an epidemic, possibly of coccidiosis, caused a considerable reduction in the numbers of grey squirrels in England, but in spite of persecution, the species is now gradually extending its range, especially in the North Riding of Yorkshire, (*Naturalist*, January 1933).

Pocock (*Field*, May 2, 1931) suggests a possibility of grey squirrel mating with red. So far as is known, all the American squirrels introduced into the British Isles are *Sciurus carolinensis leucotus*, Gapper, which occurs throughout the north-eastern United States and south-eastern Canada, lat. 44°-50° N. and long.

65°-69° W. Adult specimens in England average 600-700 gm. in weight, and their length, including tail, is about 200 mm. (Middleton). The food of the grey squirrels seems more varied than that of the red; it includes a number of plants, birds' eggs, and young birds, and the species is, as proved, a serious pest to agriculture, so much so that an anti-grey squirrel campaign was formed recently to combat it.

Breeding of Barn-Owls in Autumn

The owls (*Striges*) are amongst the least conservative of birds in their times of breeding, and while March-May are the normal times when egg-laying starts in England, it is not uncommon for young owls to be in the nest so late as October, and many cases are on record for the white-breasted barn-owl (*Tyto alba alba*), (Scott, *Field*, Nov. 28, 1931) so late as October 21, while Waterton in 1831 recorded a pair hatching their young in Yorkshire on September 7 and further noted having found a brood of young barn-owls in late December, 1823.

Wilson (*British Birds*, 23, No. 9, Feb. 1932) has worked out the fledgling period in Cheshire at 7-8 weeks, though, of course, owls commence incubating when the first egg is laid. Incubation period varies from 32 to 34 days. In all probability the increased calling of owls in the autumn and winter months, particularly the tawny owl (*Syrnium aluco*), is a commencement of the courting season, for eggs of first clutches are not unusual in February.

While the barn-owl frequently rears two broods in a season, the double brood is only occasional with the tawny owl, while the short-eared owl (*Asio f. flammeus*) sometimes rears three, though the little owl (*Athene n. noctua*) and the long-eared owl (*Asio o. otus*) are believed to be single brooded. Blyth (*Field Naturalists' Mag.*, 1) noted: "A nest of the barn-owl in this neighbourhood contained two eggs; and when these were hatched, two more were laid, which were probably hatched by the warmth of the young birds; a third laying took place after the latter were hatched: and the nest at last contained six young owls, of three different ages, which were all reared."

Surface Cultivation of Grass Land

"Scarifying grass is a new practice of some ingenious gentlemen, but not yet become a common husbandry." So wrote Arthur Young more than a century ago in regard to operations in the month of September. Since that time, it has been repeatedly shown that the proper surface cultivation of grass land ranks with manuring as a mode of improvement, and is in fact a necessary preliminary to manurial treatment on many types of hide-bound pasture. On well grazed land with a reserve of lime, hoof cultivation will usually do all that is necessary to preserve the surface free from an injurious covering of undecayed plant remains, but on acid soils in hay or light grazing, the "ingenious gentlemen" of Arthur Young's time have carried the day. Ordinary harrows are scarcely severe enough to face the matted turf of such pastures, and special implements have been developed to open up the surface, tearing out fog and moss and mixing the peaty surface layer with fresh soil from below. This operation will be in progress from now onwards throughout the dead season, and in most cases phosphatic manure or lime will be applied at the same time to encourage the spread of the wild white clover that once more finds a root hold in the broken surface.

Societies and Academies

PARIS

Academy of Sciences, August 28 (*C.R.*, 197, 541-564).
 HYACINTHE VINCENT: The rôle of coli bacillus intoxication in the etiology of certain mental troubles. Their cure by the anti-colibacillus serum. An account of cases in which the use of this serum has been successfully applied to the cure of psychoses hitherto considered as incurable. E. O. LOVETT: Certain curves which generalise conics. J. MIRGUET: Certain surfaces possessing a tangent plane. JEAN J. PLACINTEANU: Theoretical considerations on the constitution of neutrons, positive electrons and photons. The existence of negative protons. In an earlier note (*C.R.*, 196, 1474) the author formulated a hypothesis according to which a neutron is a complex element composed of a proton and an electron of negative kinetic energy. A recent note by I. Curie and F. Joliot (*C.R.*, 197, 237) according to which a proton should be composed of a neutron and a positive electron is discussed, and shown to be a consequence of the author's theory. JEAN LOUIS DESTOUCHES: The principles of general wave mechanics and the connexions between the various abstract mechanics. A. P. ROLLET and W. GRAFF: The thermal analysis of the system chlorine, phosphoryl chloride. The thermal analysis of mixtures of chlorine and phosphoryl chloride shows the existence of a compound which appears to be a phosphorus oxytetrachloride, $2\text{POCl}_3\text{Cl}_2$. This new compound forms small yellow prisms and dissociates into chlorine and phosphoryl chloride at temperatures above -55°C . SÉBASTIEN SABETAY: Antimony trichloride, a new reagent for the double bond. Antimony trichloride in chloroform solution gives colour reactions with a large number of organic substances containing a double bond: certain exceptions are noted. MICHEL BOLGARSKY: Magnetite quartzites of the circle of Man and its neighbourhood (Côte d'Ivoire). O. DUBOSCQ and Mlle. O. TUZET: Some structures of the amphiblastules of the limestone sponges.

VIENNA

Academy of Sciences, July 6. ERNST BEUTEL and ARTUR KUTZELNIGG: Sorption of iodine vapour by vegetable fibres. As regards the amount of iodine taken up, the velocity of the sorption, and the colour of the sorbate, different vegetable fibres show marked differences. The phenomena depend also, in high degree, on the relative moisture content of the air, and, in the case of cotton, on the nature of the preliminary treatment of the fibres. HERBERT HABERLANDT: Additive coloration of fluorite by calcium vapour. ELISABETH MATZNER: Destruction of the atom by neutron emission (3). HANS PETERS-SON: Short-wave generator for spectroscopic investigations. A simple arrangement for exciting gases and vapours in narrow capillaries to intense luminescence is described, and various chemical and physical actions of the discharges thus produced are recorded. GEORG KOLLER, ADOLF KLEIN and KARL PÖPL: Saxatilis and capraric acids. The empirical formula of capraric acid is changed from $\text{C}_{24}\text{H}_{20}\text{O}_{12}$ to $\text{C}_{18}\text{H}_{14}\text{O}_9$, and the acid is regarded as containing two phenolic complexes, atranol and probably orcinol; an oxylactone ring is possibly present. For saxatilis acid the empirical formula is probably $\text{C}_{18}\text{H}_{12}\text{O}_{10}$ or $\text{C}_{18}\text{H}_{14}\text{O}_{10}$. WILFRID OBERHÜMMER:

The reaction of aliphatic imino-ethers with hydrazine. MARTIN KOFLER: The daily course of the atmospheric pressure. The hypothesis is advanced that the complex diurnal variation of barometric pressure comprises two superimposed simple waves: the morning wave, intimately connected with the daily increase in temperature of the lower air layers, and the evening wave, which is probably related causatively with the daily fall in temperature of the free atmosphere. RUDOLF ALLERS and JOSEF BRILL: Behaviour of the blood-sugar of the pigeon under the action of centrally acting poisons. Experiments with amytal, morphine, urethane, chloral hydrate, and paraldehyde show that, in many respects, the reaction of pigeons towards these substances is different from that of mammals, and that the physiological effects of poisons depend on the region of the central nervous system which is attacked. F. GRÜTER, A. STÄHELI and E. STEINACH: Overcoming sterility in oxen and cows with the sexual hormone (progynon) (1). E. STEINACH and H. KUN: Removal of the psychic and somatic consequences of castration by the male sexual hormone (proviron). H. KUN: Psychic feminisation and hermaphrodisation of males by the female sexual hormone (progynon). MAX HAITINGER: Fluorescent phenomena of cerium and other rare earths. A method is described by which the marked fluorescence of these rare earths in borax and phosphate beads and also their fluorescence spectra may be observed and rendered available for analytical purposes. Much greater sensitiveness than that of absorption spectra is achieved. FRANZ HERITSCH: (1) Age of the "Troglkofel" calcareous of the Carinthian Alps. (2) Brachiopod fauna from the Nassfeld strata of the Carinthian Alps. J. KISSER: Relations between rate of germination and rate of growth of seedlings. With seeds the germination of which has been accelerated by treatment with chemical agents, the rootlets grow at the same rate as with untreated seeds. P. LAMBERT FRIES: Continuous representations of straight lines on metric spaces. ALFRED BASCH: Geometry of the Laplace field. H. RAUSCHER: Counting of condensation nuclei in closed vessels. EUGEN GUTH: (1) Semivectors, spinors and quaternions. (2) Simple derivation of the representation of the orthogonal transformations in three and four real variables by quaternions. WILHELM LENK: Investigations on the structure of spoken sounds. K. W. F. KOHLRAUSCH and F. KÖPPL: The Raman spectrum of organic substances [isomeric paraffin derivatives (4)]. Fifteen compounds, comprising sec.-butylamine, mercaptans, alkyl chlorides, and six isomeric amyl alcohols, have been examined. The results now obtained in the mercaptan series are analysed, conclusions being drawn concerning the molecular form and the activity of the free rotation. The spectra of the alcohols with branched side-chains exhibit signs of the presence of different molecular forms.

SYDNEY

Royal Society of New South Wales, August 2. C. A. SUSSMILCH: Devonian formations of the Kandos District. This district lies immediately to the west of the town of Kandos on the Sydney-Mudgee railway line. The Devonian strata are divisible into two series—the older one of Middle Devonian age and the younger one of Upper Devonian age. The Middle Devonian series is characterised by extensive beds of limestone which are quarried for the manufacture

of cement. These limestones are crowded with fossils, mainly fossil corals. In the shales underlying the limestone, an abundance of Middle Devonian brachiopods has been found while immediately above the limestone some trilobites have been collected. The Upper Devonian strata consist mainly of massive quartzites containing marine fossils. They rest upon the Middle Devonian strata without any apparent unconformity. Both series of strata have been strongly folded along the axis which trends about N.25° W. and these folded strata are truncated by an extensive peneplain developed during Carboniferous and early Permian times. R. J. NOBLE: Cultivation of mushrooms. The mushroom is regarded mainly as a delicacy rather than an article of high food value, but such is its popularity that the trade in Europe and America has now reached enormous proportions. Some 20 million pounds are sold in America each year, while at Lausanne, Switzerland, the market last year amounted to 72,121 lb. The latter were mainly collected under natural conditions, and included 41 genera and 173 species. The cultivation of the common mushroom originated in France in the latter part of the seventeenth century and commenced in the United States during the latter portion of the nineteenth century. Sporadic attempts only have been made to establish the industry in Australia, but experience of the past few years has shown that no real difficulties are encountered in the production of crops providing that conditions can be arranged to maintain an air temperature at about 60° F. and an atmospheric humidity at about 80 per cent during the growing period and that suitable materials are used. Stable manure and straw have been found most satisfactory for preparation of compost, and selected strains of mushrooms have been utilised for preparation of high quality pure culture spawn.

Forthcoming Events

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

Monday, October 23

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. Charles Singer: "The Development of the Study of Man."*

Tuesday, October 24

ROYAL SOCIETY OF ARTS, at 4.30.—W. Nowell: "The Agricultural Research Station at Amani."

ROYAL INSTITUTION, at 5.15.—Prof. G. Elliot Smith: "The Nervous System" (succeeding lectures on Oct. 31, Nov. 7 and 14).

EUGENICS SOCIETY, at 5.30—(in the rooms of the Linnean Society, Burlington House, London, W.1).—Dr. Binnie Dunlop: "Eugenics, Present and Future."*

Thursday, October 26

UNIVERSITY OF LONDON, at 5.30—(at King's College).—Prof. Martin Knudsen: "Some Aspects of the Kinetic Theory of Gases" (succeeding lectures on Nov. 2 and 9).*

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—P. V. Hunter, president: Inaugural Address.

Friday, October 27

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Discussion on "Solar and Terrestrial Relationships" to be opened by Prof. S. Chapman.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Alan E. L. Chorlton: Presidential Address.

ROYAL INSTITUTION, at 9.—Prof. E. V. Appleton: "Radio Observations during the International Polar Year, 1932-33."

INSTITUTION OF CHEMICAL ENGINEERS—(in the Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1). Prof. G. T. Morgan: "Engineering in the Service of Chemical Research."*

Official Publications Received

GREAT BRITAIN AND IRELAND

Eton College Natural History Society. Annual Report 1932-33. Pp. 42+5 plates. (Windsor.) 5s.

Journal of the Royal Statistical Society. New Series, Vol. 96, Part 4. Pp. 545-760+xvi. (London: Royal Statistical Society.) 7s. 6d.

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Session 1933-34. Pp. 382. (Manchester.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 6 (New Series), No. 8, August. Abstracts Nos. 1266-1449. Pp. 249-284. (London: H.M. Stationery Office.) 1s. 6d. net.

Department of Scientific and Industrial Research. Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research for the Year 1932. Pp. vi+58+9 plates. (London: H.M. Stationery Office.) 4s. net.

University of London: University College: Faculty of Medical Sciences. University Centre for Preliminary and Intermediate Medical Studies: Courses for Dental Students, Session 1933-1934. Pp. vi+271-806+12. (London: University College.)

Heriot-Watt College, Edinburgh. Calendar, Session 1933-1934. Pp. 347. (Edinburgh.) 1s.

Transactions of the Institution of Chemical Engineers. Vol. 10, 1932. Pp. 191. (London.)

Forestry Commission. Interim Report of the Inter-Departmental Home-grown Timber Committee, 1933. Pp. 19. (London: H.M. Stationery Office.) 4d. net.

OTHER COUNTRIES

Journal of the Indian Institute of Science. Vol. 16A, Part 3: Indian Medicinal Plants. Part 1: *Withania somnifera*; Part 2: *Swertia chirreta*. By D. N. Majumdar and P. C. Guha. Pp. 29-40. 12 annas. Vol. 16A, Part 4: i. The Colouring Constituents of Alkanet Root (*Anchusa tinctoria*, Lam.), Part 1: The Constitution of Alkannin, by Mangesh V. Betrabet and Gopal Chandra Chakravarti; ii. Note on the Constituents of the Wax from Alkanet Root, by M. V. Betrabet and G. C. Chakravarti. Pp. 41-54. 1 rupee. Vol. 16A, Part 5: The Velocity of Alcoholysis of Esters of Dibasic Acids. By Z. H. Patel and H. E. Watson. Pp. 55-69. 12 annas. (Bangalore.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 440-447: On the Mechanism of Spontaneous Expulsion of Wistaria Seeds, by Torahiko Terada, Morisō Hirata and Tyokurō Utigasaki; Rigidity of Wistaria Pod, by Morisō Hirata; On the Spark Ignition of Low Inflammable Gas Mixtures, Part 2: A Spectrographic Examination of the Ignition Spark, by Kiyohiko Yumoto; Die anomale Reflexion der schnellen Elektronen an die Einkristalloberfläche, von Seishi Kikuchi und Shigeo Nakagawa; Röntgenographische Untersuchungen über die natürlichen und regenerierten Seiden, von Ichiro Sakurada und Keiroku Hutino; Wachstumsrichtung der nadelförmigen Kristalle von Glukosepentacetat und Cellobioseacetat, von Keiroku Hutino; Studies on the Constituents of "Ginkgo Biloba L." Leaves, Part 3, by Shu Furukawa; Studies on the Constituents of "Ginkgo Biloba L." Leaves, Part 4, by Shu Furukawa. Pp. 233-235+plates 19-29. (Tokyo: Iwanami Shoten.) 70 sen.

Proceedings of the Physico-Mathematical Society of Japan. Third Series, Vol. 15, No. 8, Aug. Pp. 291-336. 70 sen. Third Series, Vol. 15, No. 9, Sept. Pp. 337-370. 70 sen. (Tokyo: Iwanami Shoten.)

Southern Rhodesia: Geological Survey. Bulletin No. 25: The Gold Outputs and Mining Activity of Southern Rhodesia, 1907 to 1932. By S. Brooke Norris. Pp. 20+2 plates. (Salisbury.) 3d.

Cornell University Agricultural Experiment Station. Bulletin 554: Cost Accounts on New York Farms. By J. F. Harriott and L. M. Vaughan. Pp. 67. Bulletin 555: Relation of Community Areas to Town Government in the State of New York. By C. R. Wasson and Dwight Sanderson. Pp. 56. Bulletin 556: Freezing Injury to the Roots and Crowns of Apple Trees. By H. E. Thomas and L. H. MacDaniels. Pp. 23. Bulletin 557: Fire Blight of Pear and Apple. By H. E. Thomas and K. G. Parker. Pp. 24. Bulletin 564: Lettuce Production on the Muck Soils of New York. By J. E. Knott. Pp. 27. Bulletin 566: Copper Seed Treatments for the Control of Damping-Off of Spinach. By P. P. Pirone, A. G. Newhall, W. W. Stuart, J. G. Horsfall and A. L. Harrison. Pp. 25. Bulletin 567: The Soils and Crop Production in Genesee County, New York. Part 1: Soils and Field Crops, by A. F. Gustafson; Part 2: Pastures, by D. B. Johnston-Wallace; Part 3: Vegetable Crops, by F. O. Underwood; Part 4: Fruit-Growing, by J. Oskamp. Pp. 87. Bulletin 572: Correcting the Unproductiveness of Acid and Alkaline Muck Soils for the Growing of Vegetable Crops. By G. M. Tait and J. E. Knott. Pp. 19. Bulletin 575: Soils in Relation to Fruit Growing in New York. Part 3: Some Physical and Chemical Properties of the Soils of the Hilton and Morton Areas, Monroe County, and their Relation to Orchard Performance. By Joseph Oskamp and L. P. Batjer. Pp. 34. (Ithaca, N.Y.)

Ingeniørvideenskabelige Skrifter. A. Nr. 35: Sub-Harmonics in Forced Oscillations in Dissipative Systems. By P. O. Pedersen. Pp. 88. (Copenhagen: G. E. C. Gad.) 8.00 kr.

Reports of the Newfoundland Fishery Research Commission. Vol. 2, No. 1: Annual Report, Year 1932. Pp. 127+11 plates. (St. John's.) 1 dollar.