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Chemistry and Citizenship

CHEMISTS, like members of other professional classes, remind themselves from time to time that their vision should extend beyond their professional interests and services into the wider field of the community at large, so that they may bring their specialised knowledge to bear on the problems which their own actions have raised. Not that scientific people are insensible to their duties as intelligent citizens—far from it; but they tend rather to measure their own success or failure in adding to the general store of knowledge, or power, or well-being through spectacles which leave out of focus important considerations none the less real because they are awkward. The physician strives to save life and prolong it; if he succeeds, we applaud him as indeed we should, for has he not contributed to human happiness? But is it, or is it not, the business of the medical man also to see that the effect of an increase in the expectation of life on, say, the vigour of the governing class, or the chance of employment, or the support of the aged, or the use of leisure, is properly examined? And if he takes up the study himself, since it is clearly impossible for him to refuse medical aid to the sufferer, is he in any better position than his patient to help in the development of a scheme of education and social order suited to the new conditions which he has created?

To judge by one or two lectures which have recently been delivered, chemists are giving attention to the social effects of their own chemistry and industry. Having invented means of producing goods with less labour (although part of the displaced labour has been absorbed in new directions of their own devising), some at least are wondering whether it is not after all their duty to do something rather more definite and vigorous about the social consequences. They are wondering whether the same amount of scientific study given to such disturbances of social equilibrium as is given to the material results of scientific inquiry might not have beneficial results in indicating the best directions of scientific development, as well as in alleviating the troubles which for all our science we have been unable to avoid. Thus Mr. W. M. Ames, in a lecture on "The Chemist and the Community" reported a little time ago in *Chemistry and Industry*, advocates the scientifically planned State as the logical sequel of the application of science to industry. He wants to establish it without interfering with the freedom of leisure, and without forgetting (as he claims rationalised industry has almost forgotten) that human nature has its failings. He proposes, for one thing, a reduction of working hours, and deplores that such a proposition has been allowed to become a political question instead of being treated as a problem of industrial management. He finds it hard to say whether or not science and human nature would come to blows during the evolution of the scientific State—for various reasons the information to be gleaned from the Russian experiment is not very helpful to others—but he declares that two million unemployed is a price we cannot afford to pay for the pleasure of muddling along.

Whatever we may think of the means available for its solution, there can be no argument about the problem. Each and every new scientific or industrial advance, whether it brings a new source of employment, a desired or enforced leisure, a longer lease of life, or a quicker way of killing people, sets up ripples and echoes which it is our

business to trace before they get beyond control and threaten to involve our social fabric in revolution instead of ordered evolution. We cannot stop learning, even to please superior people who have persuaded themselves that too much natural knowledge is antagonistic to their rules for human behaviour. They naturally prefer the latter (which admit of manipulation and alteration) to the former (which does not), and hence they complain that all this knowledge is doing us little good.

Our thesis is that more information about the social relationships of science would help to restore our balance and would lead to better government as well as better science. What, for example, is the proper attitude for scientific workers to take in relation to war? The chemist's part in modern warfare is popularly realised if not understood; and it makes good journalistic copy when normal manufacturing processes become the production of secret explosives, and poison gas exudes from every peaceful cauldron. Preparation for war does, however, call for the services of chemists, and Mr. R. Brightman, who a little time ago discussed at Manchester the place of professional organisations in society, asks scientific workers to formulate a definite ethical code towards preparation for war. In a recent issue of *The Chemical Practitioner* he points out that so long as there is real risk of war, the fullest resources of science should be used to make warfare efficient, economical and unlikely, but that "while it might be accepted as part of the scientists' general code that research work in connexion with general war needs was always legitimate, it might equally be held that research on agencies prohibited by international agreement or participation in large scale production of armaments in peace time was illegitimate".

The trouble is that any such scheme, to be effective, would have to be universal; unilateral action might well be a disservice to the cause of peace. What is the chemist to reply if he is asked to help in arranging protection for the civil population against aerial gas attacks? Is he to point to the Geneva Protocol and hope for the best, or is he to allow his natural humanity to overcome his faith in human nature? This very subject of the education of the public in means for dealing with gas attacks was quite lately discussed before the British Science Guild by Mr. J. Davidson Pratt, the general manager of the Association of British Chemical Manufacturers. The question of the scientific worker's duty in relation to the preservation of peace and to the provision of military necessities is obviously presenting doubts and difficulties to conscientious minds, which is all the more reason why the whole matter should receive earnest attention by professional organisations of scientific workers.

Mr. Ames truly says that if at any time the nation is drawn into a war the chemist's duty is the same as that of any other citizen; but that duty should not prevent him using his special powers and opportunities to strive with all his might against the warlike frame of mind and to harness the spirit of adventure to combat evils and distresses which familiarity almost persuades us to ignore. He finds the nobler adventure in a determined effort to provide work for everybody, and in doing so much he is doing more to undermine the causes of unrest.

Mr. Brightman thinks that scientific workers have come more and more to realise that, even in its narrowest sense, scientific or professional work is not something entirely apart from the life of society; that it cannot be truly isolated, and that it has to be integrated into the general life of the community. One of the ways in which this could be done more effectively would—as we have suggested before—be through the medium of the Press and of broadcasting. The social reformer gets ample opportunity for advocating his ideas for promoting the public advantage; his schemes for abolishing this and nationalising that. But the chemist (if we may take him as an example) speaks mostly through his own journals to his own people. It is necessary to impress on the public mind a picture of science in the making and science in application, to illustrate the aims, ideals and methods so familiar to the scientific worker but so little understood by the commercial public, to discuss the ways in which this new knowledge is being used, or might be used for the public good, and to examine with equal candour the possible repercussions which we would rather avoid. It is of no use trying to plan an unwilling State; nor will the State be willing until it understands a great deal more of the minds and the methods to be utilised. But it is learning by precept and by trial-and-error where organisation may usefully operate to the public profit, and where it still seems best not to limit individual freedom. The more it knows—not about chemistry, for example, but about the part which chemists play in national life—the

more will it be ready to listen to their advice; and the more chemists study the community, the more fit will they be to tender it.

Research workers cannot be a class apart in this modern world; they must mount the platform and advertise their wares. Individuals who have the ability as well as the knowledge can seek to use the popular Press as their tribune—and the Press will be willing enough if they attract readers; a science news service such as has been operating in the United States of America for some years past might be set up by a combination of professional organisations in Great Britain; and the universities might organise a comprehensive service in co-operation with the broadcasting authorities.

In any event, we shall not make the mistake of crying science as a panacea for all ills, for there are few of us who do not set great store by the preservation of moral and spiritual values; but we feel that in our scientific work we are carrying a responsibility which we cannot adequately discharge without public assistance in the widest and least mercenary sense of the term.

The Foundations of Modern Science

A History of Science, Technology and Philosophy in the 16th and 17th Centuries

By Prof. A. Wolf, with the co-operation of Prof. Dr. F. Dannemann and A. Armitage. (History of Science Library.) Pp. xxvii+693+68 plates. (London: George Allen and Unwin, Ltd., 1935.) 25*s*. net.

THE book before us deals not only with pure science, but also with technology and philosophy. It is thus able to place science in a frame of other knowledge, and show the relations and cross-connexions between them. This method is desirable, indeed necessary, if a true appreciation of the picture is to be obtained. The early development of modern science was inevitably influenced by the philosophic environment in which it grew, and gained much by the gradual improvements in scientific implements, and by the problems thrust upon science by medicine and technology.

It will be seen how wide is the field which Prof. Wolf sets out to cover. It comprises several subjects not usually included in histories of, or treatises on, science—an extension which certainly adds to the interest of the whole. But this volume is but part of the scheme. In the preface we read:

"The present book is complete in itself. It is, however, intended to be only an instalment of a complete history of science. The author proposes to deal with the eighteenth and nineteenth centuries next, and then with ancient and mediæval times. But each volume will be as nearly as possible self-contained."

This extract serves to place Prof. Wolf's work between the encyclopædic "History of Science" of Dr. G. Sarton and the various specialised histories of particular branches of science on one hand, and single volume histories of science on the other.

The two centuries under review open with scholasticism still a power, though a waning power, in the intellectual world. Scholasticism reached its zenith in the thirteenth century, when the acute mind of St. Thomas Aquinas put together a logical, and within its limits, a complete scheme of existing knowledge, based on the Christian faith as interpreted by the Roman Church, and Nature as described by Aristotle. Accepting these two authorities, the scholastic philosophy seemed to the late Middle Ages to follow by deduction both logically and inevitably. This is what Whitehead means when he describes modern science, which is primarily inductive and not deductive, as "a recoil from the inflexible rationality of mediæval thought". Wolf criticises this pronouncement, saying that "due regard for the stubborn facts of observation is an essential part of any thoroughgoing rationality". Here, I think, he somewhat misunderstands Whitehead's meaning. But he is right in pointing out the influence of the Pythagorean emphasis on number in forming the thought of Copernicus and Kepler, though he seems to miss the point that this "earlier Greek tradition" persisted through the Middle Ages, first as the leading philosophy, and then as a survival, underlying, as an alternative, the prevailing late medieval Aristotelianism.

Although Aquinas himself was ready to consider the possibility of a moving earth, the geocentric theory, in the minds of lesser men, had become part of scholasticism. Thus the Copernican revolution was not only a simplification, and therefore a mathematical improvement, on the cycles and epicycles of Hipparchus and Ptolemy, but also a threat to reduce the earth, the home of man,

from its central throne to the humbler rôle of one of the planets. Luther and his reformers opposed it from the beginning, and Catholic theologians only allowed it as a mathematical speculation. Hence, when Galileo confirmed it as physical reality by astronomical observations, and, greatly daring, set out for Rome to convert the Papal Court to Copernicanism, both scholastic philosophers and orthodox cardinals would have none of it.

Galileo's work in founding dynamics, if less spectacular than his discoveries in astronomy, was perhaps of even greater importance. Prof. Wolf gives a good account of this work taken in isolation. But here, as elsewhere in the book, there seems a certain want of appreciation of the connexions and cross-connexions which bind together the work of several men. As Mach pointed out, the fundamental dynamical investigations of Galileo, Huygens and Newton really mean the discovery of only one principle. It was an accident of history which caused force and momentum to seem simpler and more primary than Huygens' ideas, equivalent to our modern concepts of work and energy.

The chapter on scientific academies shows the great help given by them, through the association of men of science, to the early development of natural knowledge, and the account of scientific instruments makes clear the dependence of accurate measurement on the skill of the technician.

The story of the construction of the great Newtonian synthesis, in the more recent light which has been thrown on the points at issue, is well set forth in Chap. vii. The revolution in science begun by Galileo was thus, in all essentials, completed. Not until the present age was so complete a change in outlook produced in one lifetime and recognised as such by the instructed world. The full repercussion of Newton's work on philosophy was not felt until the eighteenth century, and is therefore outside the scope of the present volume, but the scientific effects were overwhelming and immediate.

The development of mathematics went hand in hand with the development of astronomy, and, if other branches of physics began each in isolation, they were preparing for mutual inter-action at a later date. Light was examined by Kepler, who gave a geometrical explanation of the telescope; Snell, who hit on the true law of refraction; Fermat with his principle of minimum time of passage which connected Snell's law with the velocities; Grimaldi, who first suggested seriously the wave theory of light; Huygens, with the principle that each small element of a wave front acts as the centre of an elementary wavelet; and Newton, who first gave the true theory of the colours of the spectrum.

Until the seventeenth century, little or no clear distinction was made between heat, fire and flame, and throughout that century there was controversy whether heat was essentially "fire atoms" or molecular motion—indeed Robert Boyle, who in general upheld the view that heat was "the super-induced commotion of small parts" of bodies, explained the gain in weight of a metal on calcination by the absorption "of atoms of fire". For a consensus of opinion about the nature of heat, men had to wait for Joule in the nineteenth century.

The vibrations of sounding strings were studied by Galileo, who realised that the period of vibration is the determining factor in the pitch of a musical note. The velocity of sound was measured by Gassendi and others, while Guericke, after inventing the air pump, showed that sound would not travel through an exhausted space.

The modern experimental science of magnetism and electricity was founded by Gilbert of Colchester. Descartes attempted to explain magnetism by an application of his general theory of vortices, but, except for various observations on the mariner's compass, not much more was done during the period.

Meteorology, like other sciences, depends on suitable instruments, and until the invention of the thermometer, barometer and rain gauge, nothing much could be done. But with them a number of continuous meteorological records were made in the seventeenth century. Among the navigators, William Dampier made observations on winds and ocean currents, while the physicists Halley and Hooke speculated as to causes.

At the beginning of the period, chemistry was subject to three main tendencies: (1) the alchemists' search for the philosophers' stone; (2) the use of chemical remedies in medicine, especially by Paracelsus; (3) the need of chemical knowledge in the mining industry. This last subject is of great interest; it is not often mentioned, and Prof. Wolf does right to bring it forward. As regards chemical theory, until Robert Boyle published the "Sceptical Chymist" in 1661, it was a mass of confused notions, in which explanations were sought in Aristotelian terms of occult qualities or 'substantial forms'. Boyle was followed by Lower and Mayow, who combined chemical with physiological researches, and did much to elucidate the process of respiration.

After chapters on geology and geography, we come to the biological sciences, which, subordinate to medicine at the beginning of the period, won an independent place in its course. A quite new

field of research was opened up by the invention of the microscope, while physiology was revolutionised by Harvey's discovery of the circulation of the blood. Thus Prof. Wolf passes to medicine, with an account of the most famous physicians of the time.

The chapters on technology show that, during the period under review, "science learned from existing technical methods rather than taught them". The converse effect only became generally important at a later date. But the accounts of agriculture, textiles, building problems, mining and mechanical engineering illustrate the gradual application of more systematic methods in industry. These accounts are accompanied by copies of many contemporary prints.

The chapter on psychology perhaps suffers somewhat by being placed before and not after that on philosophy. The chapter on the social sciences contains interesting reproductions of early Bills of Mortality and other examples of the introduction of statistical methods into the study of social phenomena, while it is shown that the problem in practical economics which occupied the statesmen of the time was based on the idea of increasing national wealth by a "favourable balance of trade", whereby not only necessary commodities but also an excess of precious metals might come from abroad.

The final chapter traces the formal separation of science from theology and then from philosophy, and their mutual reactions when each was pursued by methods of its own. In this chapter more might have been made of the fundamental change wrought by Galileo. His work replaced the homocentric philosophy of scholasticism, with space and time as unimportant categories, by a return to the concepts of Democritus, who visualised reality in terms of atoms and a void, and reduced the qualities of colour, sound, taste, hotness and coldness to mere sensations in the observer's mind. The rest of the chapter traces well the thought of such men as Bacon, Hobbes, Descartes, Spinoza, Locke and Leibnitz, and ends, as a book on seventeenth century science should, with Newton. Prof. Wolf is to be congratulated on a volume, which, if not perfect, is yet a notable achievement. W. C. D. DAMPIER.

The Salamander

The Anatomy of the Salamander

By Dr. Eric T. B. Francis. With an Historical Introduction by Prof. F. J. Cole. Pp. xxxi + 381 + 26 plates. (Oxford : Clarendon Press ; London : Oxford University Press, 1934.) 25*s*. net.

SALAMANDER is a name not unknown to folklore, mythology or even slang. Henceforward it must be more than a nominal acquaintance of every zoologist, without distinction of creed or class, for Dr. Francis has given us a book with a much wider appeal than its title would suggest. In his preface the author says that : "Its intention is to provide a general account of the anatomy and morphology of a tailed Amphibian—the Salamander, which shall, within limits, be comparable with the work of Ecker and Gaupp on its ecaudate relative—the Frog". There can be no doubt of his successful achievement of this object, and the two works are not only comparable but also complementary ; the easiest way of discovering the latest morphological nomenclature and the most recent views on the homologies of anuran structures is to compare the relevant sections in the two books.

The system of the two is essentially similar. Each group of organs is considered separately, its components being described fully but concisely, and illustrated by numerous clear, diagrammatic figures ; following each chapter are the pertinent references. But although the system is similar, there is one very important difference in the descriptive methods. Dr. Francis is never didactic, and in any instance where there are differences of opinion an impartial summary of the conflicting points of view is given. Though the book is primarily intended for the amphibian morphologist, whether student or teacher, it is these critical summaries, and the references, which render the volume so useful to other vertebrate zoologists.

The bibliography contains no less than 840 titles (of which only four per cent have not been personally examined by the author) and, though this testifies to the enormous amount of work which has previously been done on the subject, Dr. Francis is no mere literary compiler. There are numerous original observations, and the author has personally investigated all the structures he describes. Modern technical methods have been utilised to check the findings of earlier workers, and special or new methods are described where they have been found particularly suitable.

No work of this magnitude can be perfect in

every way. The arrangement of nearly all the figures on a series of plates at the end of the volume does not make for ease of reference, especially as many of them are exceedingly intricate; to follow the text in one place, the figure in another and find the meaning of an abbreviation on the plate (there are more than nine pages of these abbreviations) is no light task.

Again, the taxonomic and zoogeographical chapters are disappointing, for nothing is said of the numerous described subspecies of the salamander and only three 'varieties' are recognised. What the author's concept of a 'variety' may be is not explained, but as the '*var. molleri*' is said to occur all over the Iberian Peninsula side by side with the '*Forma typica*' it is presumably not the same as a subspecies. No explanation of the use of the name *molleri* (the date of which is wrongly given as 1896 instead of 1889) in preference to the older *galliaca* is offered, and the map showing the species as occurring in the Balearic Islands, Sicily, Crete and Cyprus is very misleading. But, since these chapters are merely incidental to the main theme, and are, moreover, merely repetitions of mistakes by other workers, they do not seriously detract from the value of the book for its primary purpose. There are also some slips (such, for example, as in references 779–781, where the author's name should read "Werner" instead of "Weliky"), which will prove troublesome to the student, and though trivial in themselves are blemishes on an otherwise admirable piece of work.

Modern Views on Magnetism

Magnetism and Matter

By Dr. Edmund C. Stoner. Pp. xv+575. (London: Methuen and Co., Ltd., 1934.) 21*s*. net.

DR. STONER and all physicists interested in magnetism are to be congratulated on the appearance of this admirable monograph. In 1926, the author published a book on the same subject, "Magnetism and Atomic Structure". The present treatise, far from being merely a revised edition of its predecessor, is practically an entirely new work, in which full justice is done to the considerable progress resulting from experimental and theoretical research in the course of the last ten years (electronic spin, quantum mechanics, etc.).

After a historical introduction, which makes delightful reading, short accounts are given of the necessary theoretical tools of classical and quantum physics in Chapters ii and v respectively, Chapter iii giving a lucid exposition of experimental methods and Chapter iv describing earlier results and theories (Ewing, Curie, Langevin, Weiss). After three chapters on the Zeeman effect (in atomic spectral lines only), magnetic deviation of atomic rays and gyromagnetic effect, an extensive review is given of diamagnetism (Chapter ix, pp. 251–279), paramagnetism (Chapter x, pp. 280–349) and ferromagnetism (Chapter xi, pp. 350–437), the author's interest being everywhere harmoniously divided between the exposition of facts and of their theoretical interpretation. Then follows an account of Kapitza's measurements in very strong fields (Chapter xii), of molecular magnetism (Chapter xiii) and of the magnetic properties of metals and alloys (Chapter xiv). The work ends with useful appendixes and an extensive author- and subject-index.

With a vast subject such as magnetism, it is often a very difficult question to what extent experiments and theories claim a general scientific interest. The author's choice in this respect is very much to be admired indeed; his own important contributions to the theory, for example, have been presented in the same objective manner as those of others, and he has shown a very wise self-restraint in practically leaving out such subjects as magneto-optics and magneto-electricity. At the same time, the reader gets a vivid impression that magnetism is a very living branch of physics nowadays; many of the theories recorded still bear a strongly speculative character, but the way in which it is done adds highly to the charm of the book. Consequently objections which here and there can be raised may easily be due to personal taste.

The classical discussion of the energy of a magnetised body in Chapter ii is, in the reviewer's opinion, scarcely a satisfactory basis for the general laws which are derived from it. More attention might perhaps have been directed to the calculations of Penney and Schlapp, which give an important contribution towards the understanding of the wide applicability of Weiss's law in paramagnetics. As regards anisotropy of ferromagnetic single crystals, it is questionable if the current atomistic explanation of this phenomenon can withstand the touch of criticism. Remarks like these, however, if valid at all, do not affect the intrinsic merits of Dr. Stoner's excellent book.

H. A. K.

Veterinary Helminthology and Entomology: the Diseases of Domesticated Animals caused by Helminth and Arthropod Parasites. By Prof. H. O. Mönnig. Pp. xvi+402. (London: Baillière, Tindall and Cox, 1934.) 30*s*.

PROF. MÖNNIG, who is professor of parasitology in the Veterinary Faculty of the University of Pretoria, is well-qualified to write a work of this character. The aim of his book is to give an account of the helminth and arthropod parasites of domestic animals and, at the same time, to stress those practical aspects of the subject most useful to the veterinarian. The morphology of the parasites concerned is dealt with in a general way and sufficient account is given about their general characteristics to enable specific parasites to be identified. The parasitic diseases themselves and their treatment come in for rather fuller consideration. The chief parasites of the common domestic animals of the world, and also kindred creatures affecting fur-bearing mammals, are included. If important parasites have been omitted it is only because, the author states, discrimination on this subject is difficult on the basis of existing knowledge.

The book is divided into four parts or sections, of which Sections I and II are brief (they occupy together less than 22 pages) and are mainly introductory. Section I is concerned with the general subject of parasitism, resistance and immunity, pathogenicity and kindred topics. In Section II methods of preserving and mounting material are described, but the part is devoted more especially to clinical methods of diagnosing parasitic diseases. The longest part of the book is Section III, on helminth parasites (more than 230 pages), while Section IV, on arthropod parasites, occupies about 133 pages. The author evidently favours the helminths more than the arthropods, and their treatment is often more detailed, apart from the fact that they include the larger number of species of veterinary importance.

The subject matter of the book is well arranged and thoroughly up to date, while the illustrations are admirably clear and well executed and the majority of the figures are new and original. The book will undoubtedly well serve the purpose intended, and should meet the requirements of both the student and practising veterinarian. It should also be on the shelves of zoological libraries.

Qualitative Analyse mit hilfe von Tüpfelreaktionen: theoretische Grundlagen, praktische Ausführung und Anwendung. Von Dr. Fritz Feigl. Zweite, verbesserte und vermehrte Auflage. Pp. xii+513. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935.) 28 gold marks.

IT is gratifying to note that the second edition of this invaluable guide to 'spot' tests has been published within four years of the first edition (reviewed in NATURE of December 12, 1931), and that it has not been necessary to raise its price, in spite of the fact that it has been enlarged and partly rewritten. Actually, the number of pages has been increased by more than thirty per cent, much of the increase being necessary to include work, published and unpublished, carried out in the author's own laboratory.

Besides covering in the most detailed manner every variety of spot test for inorganic and for organic substances, the book contains 116 pages of theoretical discussion, under which head are considered complex-formation, co-ordination of elements, poly-acids, catalysed and induced reactions, the various groups 'specific' to particular metals and so on. Many of the tests appear twice in the book, according to whether *A* is used as specific for *B*, or *B* as specific for *A*. At the end of the book is found a tabular summary covering ten pages, an author index covering nine, and a subject index covering nearly nineteen. The utility of the book should secure for it a wide public, quite apart from its inevitable appearance on the book-shelves of every micro-chemist. A. L. B.

War Office. Textbook of Mechanical Engineering Pp. xv+690+xx. (London: H.M. Stationery Office, 1934.) 12*s*. net.

THIS is the best twelve shillings' worth of information on mechanical engineering we have ever come across, and it is scarcely possible to conceive a better guide for the young engineer. In it theory and practice are combined in an admirable manner, and it is full of those 'wrinkles' which only the experienced engineer can impart. It covers workshop practice, all the ordinary types of reciprocating steam, petrol and oil engines, boilers, power transmission, lubrication, air compressors and refrigeration. There are diagrams, tables, charts, bibliographies and a good index, and the information is conveyed with an economy of language which sometimes reminds one of the drill shed. The production of the book it may be presumed is the result of team work, but it is quite evident that a good deal of credit is due to the editor, whoever he may be. E. C. S.

A Guide to the Constellations By Prof. Samuel G. Barton and Prof. Wm. H. Barton, Jr. (McGraw-Hill Astronomical Series.) (Whittlesey House Publication.) Second edition. Pp. x+74. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 15*s*. net.

THE first edition of this atlas was noticed in NATURE of November 10, 1928 (p. 723). In the new edition the authors have made slight alterations to the text, necessitated by recent developments such as the discovery of Pluto. The charts themselves appear to be unaltered, and the opportunity has not been taken of introducing the new constellation boundaries as defined by the International Astronomical Union. This, however, is of minor importance to the class of readers for whom the book is intended, and who will find it not only an excellent help in becoming familiar with the constellations but also a trustworthy source of elementary astronomical information.

The Medical Curriculum in Great Britain*

University and other Qualifications

Training and Examinations

ENGLAND has been hearing a great deal about the training of medical practitioners. All through the spring months ran the long drawn examination by a Committee of the House of Lords of the evidence for and against the bill proposing that osteopaths should be accepted as medical men. The bill was withdrawn, and it may be hoped that the lay public accepted that decision with satisfaction, though it is doubtful whether they could follow the arguments of the medical experts who sought to emphasise the essential value of what was given by the orthodox medical curriculum in training the practitioners whom the country requires for its manifold services in matters of public and private health.

Now, immediately after the ending of this debate, comes a report of high authority confessing that the medical curriculum itself is in need of amendment, and proposing substantial changes. The fault here is of a very different nature and the contrast should be noted. The osteopath sought to be accepted as a medical practitioner on a scanty curriculum bent around a fundamental hypothesis of the cause of all diseases which had no relationship to the steady advances of scientific knowledge in biology.

Orthodox medicine moves forward in close harmony with every advance in modern science, gaining understanding of disease and power to control it from the physicist, the chemist, the zoologist, indeed from all except the successors of the old astrologist. Each such step forward in medical knowledge may mean the chance of its application to some individual patient, and the teacher of medicine, thinking of those patients whom his students may have to tend, feels his duty to be that no detail of possible value shall be omitted. So the student's memory is overburdened and he loses thoughtful education. The medical curriculum is not too scanty but too full.

The need for a revision of this curriculum—a rationalisation to use the latest phrase from the world of industry—has been urged again and again, by students as well as by teachers. There seems to be a greater difficulty in planning a course that shall combine education of a university type with adequate vocational training in the subject of medicine than is met with in engineering, chemistry or law. The medical man, when qualified by the final examination, is expected to be able in his independent judgment and knowledge to handle rightly one and all of the practical problems that may arise in human illness. There is no later stage of apprenticeship for him, and the routine training must be thorough and exact.

The general scheme of this training in its minimal form is outlined by the General Medical Council, a body which does not itself examine candidates or grant diplomas. Each university is free to arrange its own course of instruction and its examinations for its own degrees, provided that the standard for the latter does not fall short of the minimum prescribed by the General Medical Council. Outside London, this freedom has been used from time to time in remodelling the courses of medical education, and quite easily because each university could assemble its teachers and decide upon an agreed policy. But London in its hugeness was confronted with peculiar difficulties. The University of London contained not one but twelve medical schools, all teaching for the University degree but with teachers who until recent years did not feel inclination to obey a central University authority. Side by side with the University in the metropolis was another examining, but not teaching, body with power to grant a qualifying diploma, that of the Royal College of Physicians and Royal College of Surgeons. This Conjoint Board diploma was governed by its own curriculum, arranged in complete independence of the University of London and with its examinations graded in such a way that almost all the University of London students found it advantageous to take the Conjoint Diploma first, despite the additional and heavy fees entailed; and then a large proportion of them never troubled to complete their University course. With this alternative road to a vocational qualification lying open to its students, the University lost full liberty to make its own decisions as to the training of these men.

An added complication came from the medical schools of Oxford and Cambridge. These Universities

* Report of the Conference of Representatives nominated by the Universities of Oxford, Cambridge and London, the Royal College of Physicians of London, the Royal College of Surgeons of England, and the Society of Apothecaries of London, on the Medical Curriculum. Pp. ii+34. (London: University of London, 1935.)

granted a medical degree, but taught only the pre-clinical subjects. Almost all their students went for clinical training to London, to be taught in the curriculum of the University of London. Cambridge was eager for changes in the course of training, but its hands were tied because it had no power to change the routine of teaching in the London schools. Moreover, any alteration in its final examinations which might introduce difficulties for Cambridge students was open to the danger that they would simply cease to present themselves for the Cambridge degree. For the Cambridge and Oxford men, like those of the University of London, almost all secured their position in practice as early as possible by taking the separate Conjoint diploma of the Royal Colleges.

While Oxford and Cambridge were thus hindered in their desires for reform of the curriculum, London also lost some of its freedom for independent action owing to the presence of the students whom it welcomed from the older Universities. These men were not registered as students of the University of London, but Oxford and Cambridge would have felt the discourtesy if London had introduced large changes in its curriculum without inquiring how such changes would affect the course of clinical studies ordained, though not taught, by the two Universities for their students whom they sent to London. The only body that was really free for independent action was the Conjoint Board. It arranged a good practical curriculum and a sound clinical examination, though on the simple lines of a vocational training. Its demands could be less than those of a university, and it was in the position of established strength. Two thirds of the London students were content with the diploma of the Royal Colleges and never completed the University course.

These obstacles to independent action have been surmounted in the only possible way. In 1932 the Senate of the University of London invited the Universities of Oxford and Cambridge, the Royal College of Physicians of London and the Royal College of Surgeons of England to appoint representatives for a conference on the defects of the medical curriculum. The proposal was received with good will and friendliness by all. An executive committee was appointed, and in two years the Report of the Conference was issued, on April 30, 1935. Though so many bodies and so many different subjects in medical education were represented, the work of the Conference and of the Committee went forward so quietly that little discussion of the questions was excited outside the Conference itself, and the Report is signed with agreement of all its members. It is an excellent document, and the acceptance of its main recommendations and especially of its spirit by the university and other authorities concerned would improve notably the education of medical students in the metropolis. The number of the latter is larger than is commonly realised. The Medical Register shows a total of about 1,500 men and women accepted each year as newly qualified doctors. Approximately one half of this total for the whole of Great Britain receives clinical training in London. The Report has a larger responsibility than even the names of Oxford, Cambridge and London might suggest, for it considers the education of half the medical men in Great Britain.

The Report emphasises one leading principle, that education of intelligence is required, so that the student's mind may "acquire that kind of culture which survives the forgetting of facts". Again and again attention is directed to the excessive loading of the memory with details for the purpose of passing some examination which stands as a high fence before the student can pass from one closed field of the curriculum to another. Many of these facts resemble the leaden weights which a horse must carry for a handicap race, useless and discarded as soon as that particular race has been run. The Report aims at lessening the isolation of one field of knowledge from another in the progressive curriculum, seeking for example to carry physiology onward to help in experience at the bedside, while bringing illustrative material from the hospitals into the preclinical years to emphasise the aim of physiological or anatomical studies. The hope is to produce the trained intelligence, and the memory which is exact in that which must be remembered for the sudden needs of action or decision in medical work, but is not burdened with those innumerable details of secondary importance which any intelligent person would know how to find in a book when he needs them. That type of mind will not be produced unless the work of the curriculum allows reserve energy and time for thought. A lightening of the load as well as a modernisation of its content is required, and it is essential that the recommendations of the Report be judged with close attention to this primary need.

The Report does not suggest any change in the total period of medical studies for qualification, namely five years, or in its present division of two years for the preclinical period (anatomy, physiology, etc.) and three years for clinical studies. But the intermediate subjects of the preclinical years are to undergo some change. Anatomy and physiology, with biochemistry, will both receive rather less of the student's time, and they are to be illustrated towards the end of the period by

examples of derangement of normal structure or function as seen in hospital practice. In both subjects it is directed that the examinations shall not involve "burdensome memorisation of detail", structural or otherwise, but shall rather test the student's grasp of principles. Professors of anatomy and physiology are not likely to be dissatisfied with this. Their own courses of academic training for higher degrees in these subjects have generally been distinguished from that provided for medical students by the emphasis laid in examination on the comprehension and intelligence of the candidate rather than on a routine load of information. It is the type of medical examination hitherto in vogue which has insisted on minute topography or memorised physiology. But in one respect the physiologists until recently have been to blame, since they were slow to meet the needs of medical students by illustrating their science through observations on man or even on the mammal. It was once said that physiology never taught the essential facts of the catamenial period because menstruation did not occur in the frog. That reproach now belongs to past history.

Pharmacology is also eased, by attaching the subject to physiology, abolishing its special examination, and no longer requiring at this preclinical stage the purely artificial knowledge of doses of drugs and their therapeutic applications. But the leisure time that may perhaps be gained by changes in these three original subjects of the intermediate course is not left idle. Two new subjects are to be introduced, each on a minor scale. The first is an admirable choice, psychology or, as it might better be termed at this stage of the curriculum, the physiology of the mind and emotions. Eight lectures, presumably without practical experiments, are to be given and not to be followed by an examination. Medical psychology and psychiatry form a subject of immense importance both in the therapy of patients, whether physically ill or mentally afflicted, and in public health. But the subject has grown up in its own house apart from the so-called exact sciences. The medical student does not make acquaintance with it until near the end of his clinical training, and then too often in only a perfunctory way that makes him fail to grasp its high importance. In his clinical period he soon discovers that much of what is taught to him on any question in the wards lacks rigid scientific proofs, and he becomes habituated to a different set of values in the art of medicine. Psychology exists to him only in that later environment. The subject cannot but gain in strength if it is shown to be capable of a scientific exposition that will endure comparison with that of physiology, and its obvious interest may then prove powerful enough to determine some of the best of the younger men to devote their lives to the advancement of the science of mental diseases, a recruitment that is sorely needed.

The second new subject to be introduced is one which definitely links the preclinical with the clinical subjects, namely pathology in its general aspects including bacteriology. This is to be studied in the last two terms of the preclinical course, and with such seriousness that an examination in it is to be grouped with those on anatomy and physiology at the end of the preclinical course. This introduction is also a reasonable and good choice, for it prepares the student to think scientifically of disease by comparison with normal anatomy and physiology; but with the examination added it most emphatically cannot be regarded as a lightening of the curriculum at this stage. The general conceptions of pathology do not follow directly from the knowledge of normal anatomy and physiology. They are new phenomena which require time for their comprehension and some practical experience, whether this be got by laboratory experiments or by seeing human disease. Yet the student is expected to pass an examination in this new subject after a short course and at a time when he needs all his spare energy for ensuring success in the examination in anatomy and physiology which must be passed before he is allowed to move on to his clinical studies. Surely it would be wiser to give the preliminary course but to defer the examination until knowledge can ripen with fuller experience and with time for thought on that experience.

The advocates of pathology are continually increasing their claims on the medical curriculum. In 1922 the clinical period was extended from two years to its present time of three years, and that at once gave an extra year to pathology, which is taught or studied throughout all phases of the clinical period. Now, though normal anatomy and physiology are being pruned to a limited spread of growth in their short preclinical season, pathology and bacteriology are to be extended backwards for another six months, to take root in the preclinical time, to spread over all the three clinical years, and stand strongly as a separate subject in the final examination itself. One is reminded of the triumphant song of Psalm lx. "Moab is my washpot: over Edom will I cast out my shoe." But this conquest is no lightening of the burden of the curriculum, either at the beginning or the end. Academic pathology, as a science, may be more essential for the study of medicine than either anatomy or physiology, but it is difficult to justify two examinations in it when one suffices for each of the latter subjects.

The final examination in pathology, as at

present held, involves as burdensome a loading of the memory as the examinations indicated for amendment in anatomy and physiology; and it comes at a more grievous time when the student requires all the spare crannies in his memory for necessary details of clinical work. It would have been a real liberation for him if pathology had been satisfied with one examination only, about the end of his second clinical year, so that, well trained in rigid scientific thought by anatomy, physiology and pathology successively, he could then devote himself to his final clinical subjects and, under the guidance of clinical teachers who would also be his examiners, prove his intelligence in the application to medical problems of these fundamental scientific subjects. A modern clinician in a good hospital, whether he be surgeon or physician, is guided in all his thoughts by applied physiology and pathology: indeed he is more alert to employ physiological knowledge for the investigation of clinical problems than is the pathologist, who tends to restrict his outlook to morbid anatomy and immunology. It is essentially the clinician's duty to apply in his work the principles derived from the sciences of physiology and pathology, and to explain their application to the student when the latter has learned these sciences in their academic aspect apart from the individual patient. If the clinical teachers cannot use this knowledge in his work, the student will be driven to think that it is all artificial and a weariness added to his mind. It is not reasonable to impose at the end of the clinical period a separate examination controlled by pathologists who are likely to demand from the student, just when he is maturing to clinical skill, a greater load of pathological information than he or even a senior clinician can employ in work with patients.

For the clinical work of the final three years the Report has no considerable changes in view. It stresses that more attention should be given to attaining practical familiarity with minor ailments and with common diseases of the skin, eye and ear, which tend to be segregated in special departments of a hospital. The required time may be found in curtailing that of attendance on such major operations as in later practice will fall only to the surgical specialist. Emphasis is rightly laid on the need for fuller practical instruction in the psychological aspects of ill health; and a special course of lectures is demanded for public health and State medicine, including forensic medicine. All these are additions obviously needed for the education of the ordinary practitioner, but nothing has been put aside to make room for them.

The most fundamental change of all in the clinical period is that recommended for the sequence of the final examinations. Hitherto obstetrics and gynæcology have been grouped as a small subject, easily methodised in teaching, and often cleared away by the student as a preliminary to his more serious approach to medicine and surgery. That meant a lower standard of skill in a subject where recent developments in public health services have actually been tending to require that the practitioner shall at once be competent to assume the position of a consultant with ripe experience. So the order of examinations has been reversed, and obstetrics together with diseases of children and State medicine are to form a senior subject in Part II of the final, which cannot be passed until the student has completed his examination of medicine and surgery. This change would undoubtedly fit the doctor better for his important duties in relation to national health, though actually it cannot but constitute an increase in his curriculum, because a higher standard of knowledge will be demanded for subjects that at present are treated too lightly. The Report offers no advice as to the time when these different examinations may be attempted in the final period, but it is assumed that all can be completed by the end of the three years.

The formal decisions now lie with the Universities and the Conjoint Board. If the recommendations of the Report are generally accepted, the education of the doctor will be more intelligent and far better adapted to the needs of modern practice. But the examiners will still be waiting at the Caudine Forks. Unless they alter their present attitude and in advance of the examinations reassure the student that the change is real, he will continue to load himself as before with every odd scrap of knowledge that he fancies may be called for at his trial. Then the new subjects will be found to have added to the present burden of the curriculum and all will be heavier still. Someone recently compared the weight of kit carried by the British infantry soldier in comparison with his body weight and muscle to that which is the regulation maximum for horse and camel in the same scale of comparison. The infantryman would be fairly loaded at 30 lb., but his determination enabled him to struggle along with twice that weight as modern science altered warfare and new devices were continually added to his original kit. The medical student is in a like plight, and he too carries on. The difficulties of his toil have been recounted by the Dean of St. Mary's Hospital, Dr. C. M. Wilson, in an article justly entitled "The Student in Irons"*. If the examiners accept the spirit of the present Report, they can do much in helping to unshackle a very willing worker. T. R. E.

* *British Medical Journal*, March 12, 1932.

Biological Control of Coconut Scale in Fiji*

SUCCESSFUL INTRODUCTION OF A COCCINELLID BEETLE

By Dr. A. D. Imms, F.R.S.

MR. T. H. C. TAYLOR has recently prepared a lengthy paper describing biological methods of controlling the scale insect *Aspidiotus destructor* in Fiji. From the economic point of view, this pest causes extensive damage in Fiji to coconuts, bananas, 'yagona' and avocado. The present paper deals more especially with the insect in relation to the copra industry, of which it is a most serious enemy.

It is not known how, or exactly when, the scale insect became introduced into Fiji; but it was already a pest in the year 1912. Neither chemical nor mechanical methods of control for insects attacking coconuts can be satisfactorily employed in the islands on account of labour being expensive and relatively scarce. Furthermore, the coconut estates are not sufficiently localised to allow of a power sprayer being used without incurring excessive costs for transportation. Attempts were made to control the *Aspidiotus* in 1920, when certain parasites were introduced from Tahiti, notably the species *Aphelinus chrysomphali* and *Aspidiotiphagus citrinus*. In 1927, other parasites and also certain predators were imported from Java, but neither of these schemes of parasite introduction proved productive of appreciable economic results.

It was not until 1928, when several species of predators were obtained from Trinidad and introduced into Fiji, that a solution of the problem was obtained. The fact that certain Coccinellid beetles had been observed to be important factors in the repression of the *Aspidiotus* in Trinidad led to five species of the family being introduced into Fiji. The metamorphosis and biology of these insects are carefully described and figured. Of these, *Cryptognatha nodiceps* proved far superior as a controlling agent to any of the other four species, and attention was mainly centred upon it.

As a means of controlling the *Aspidiotus*, *C. nodiceps* proved to be a remarkable and spectacular success. Only nine months after the shipment was landed in Fiji, and liberations made, the scale insect was brought under control in all the more important islands of the group. After a further nine months, the scale was not only controlled on every single island, but also became so rare in many localities where it formerly abounded that living batches could only be found after much searching. Up to the time of writing his paper (July, 1934), Mr. Taylor states that the Coccinellid has not only reduced the appearance of the scale to negligible proportions, but is also apparently maintaining a permanent effective check upon it.

The complete success of the introduction of *C. nodiceps* is attributable to a combination of facts. First, it breeds continuously with a high rate of multiplication throughout the year in Fiji. It is a voracious predator, both as larva and adult, and in the latter phase it is long lived. Secondly, it has remarkable powers of dispersal. Thirdly, it has no serious natural enemies in Fiji. Finally, the *Cryptognatha* is able to survive even when the *Aspidiotus* has become reduced to a condition of great scarcity. In this connexion, the fact that it has an alternative host in another scale insect, namely, *Diaspis pentagona*, which is not a serious pest in Fiji, is important.

When a parasite or predator is introduced into a new country, where the *Aspidiotus* is rampant and occurring in outbreak form, it must be capable of multiplying and dispersing sufficiently rapidly to 'overtake' the pest in the worst outbreak. Also, having repressed the scale to an economically negligible condition, it must be capable of maintaining such a phase. It appears that none of the parasites previously introduced is capable of fulfilling these conditions and was consequently foredoomed to failure. Each individual parasite can only destroy one individual pest and none is capable of greater multiplication than the latter. It is only an insect like *C. nodiceps*, of quite exceptional voracity and with a very high multiplication rate, which can possibly control the outbreaks in question. Each individual *nodiceps* is capable of destroying hundreds of scale insects, in all stages, during its life and of bringing about a far greater destruction rate than that achieved by any of the parasites. Whereas the latter, theoretically at least, are capable of maintaining the scale in a non-outbreak condition, their biological attributes are such that they are inherently incapable of bringing about that condition in the first place.

* "The Campaign against *Aspidiotus destructor*, Sign. in Fiji." By T. H. C. Taylor (with three sections by R. W. Paine). *Bulletin of Entomological Research*, **26**, 1–102, with 40 text-figures; 1935.

Obituary

Dr. Herbert H. Thomas, F.R.S.

THE sudden death on May 12 of Dr. Herbert H. Thomas, petrographer to H.M. Geological Survey, at the early age of fifty-nine years, has caused a sad gap in the ranks of British geologists, and deprived a large circle of a warm friend and helpful adviser. To brilliant academic attainments he added further lustre during his subsequent geological career. His wide interests and accurate knowledge were readily placed at the service of those who consulted him, and his sympathetic nature made him an unusually large circle of friends. To know Thomas was to love him.

Educated at Exeter School, where his family then lived, Thomas entered Sidney Sussex College. In due time he obtained a first class in Part I and in Part II of the Natural Sciences Tripos ; was awarded the Harkness Scholarship (1898) and the Sedgwick Prize (1906). In 1898–1901 he acted as assistant to Prof. W. J. Sollas at Oxford. In 1901 he was appointed geologist on H.M. Geological Survey and was assigned to the South Wales district ; just at the time when the classic district of Llandeilo was about to be entered by the surveyors.

Thomas, trained at Cambridge, had the good fortune to be associated with T. C. Cantrill, who was a pupil of Lapworth at Birmingham. Both these officers had been imbued with the work of Lapworth and of Marr and others of the Cambridge School on the Lower Palæozoic rocks. At the same time, Sir Jethro Teall had been appointed director of the Survey. The conditions were therefore exceptionally favourable to the adoption by the Geological Survey of Lapworth's threefold classification of those rocks which is now in universal use in place of Murchison's classification, previously used on its maps and in its memoirs. Thomas remained on the field staff until the completion of South Wales in 1911, when he was appointed petrographer—a post for which his training and interests in mineralogy eminently fitted him. He retained, however, a keen interest in the older rocks of South Wales, and frequently returned to attack their problems. Several papers appeared in the *Quarterly Journal of the Geological Society* jointly with O. T. Jones and with A. H. Cox.

In later years, Thomas's official duties brought him into intimate contact with the officers of the Scottish branch of the Geological Survey who were engaged in examining the Tertiary igneous rocks of the west of Scotland. When he was president of Section C of the British Association in 1927, he gave a brilliant address on the Tertiary volcanic history of north-west Britain. His interest in mineralogy, which had begun in his youth among the mine-heaps of Cornwall and Devon, was maintained throughout his career, as instanced by his valuable contributions on the minerals of the Trias of the south-west of England and papers on minerals and optical apparatus which were contributed to the Mineralogical Society, of which he was an active member.

Largely through association with T. C. Cantrill, Thomas took a keen interest in prehistory, and his wide knowledge of igneous rocks and their distribution was readily placed at the disposal of many visitors to the Geological Survey offices in Jermyn Street, who brought for investigation, stones, axes and other objects of archæological interest. By his fortunate acquaintance in the field with the igneous rocks of Pembrokeshire, he was able conclusively to solve the mystery of the blue-stones of Stonehenge, which had previously been assigned to many and diverse sources, and to show that they had been derived from a small area surrounding Carn Meini in the Precelly range.

Thomas was awarded the Murchison Medal in 1925 by the Geological Society of London, of which he was secretary from 1912 until 1922 and vice-president from 1922 until 1924. He also served on the Council of the Mineralogical Society. He was elected to the Royal Society in 1927, and at the time of his death was on the Council. He is survived by his widow, one son and one daughter.

Mr. J. E. Quibell

THE death is announced of James Esward Quibell, well known as an Egyptologist, at the age of sixty-eight years. Born at Newport, Shropshire, he was educated at the Newport Grammar School and at Christchurch, Oxford, of which he was an exhibitioner. After taking honours in Classical Moderations and the Final School of Natural Science, he engaged for a time in teaching ; but travel in Egypt attracted him to archæology. He joined Prof. Flinders Petrie, assisting in the excavation of Coptos, Nagada, El Kab, Hierakonpolis and other sites. After a brief period of study at Berlin, he was appointed to the Catalogue Commission of the Egyptian Museum, Cairo, and in 1899 became an inspector in the Egyptian Antiquities Department.

Quibell conducted excavations in Upper Egypt and at Saqqara for a number of years and then in 1913 was made keeper of the Egyptian Museum, a post which he held until his retirement in 1925, although for the last two years of his tenure he acted as Secretary-General to M. Lacau, Director-General of Antiquities. Two years later he suffered serious loss in the death of his wife, a daughter of Principal Pirie of the University of Aberdeen, herself a distinguished archæologist. Notwithstanding the break in his life occasioned by this loss, he continued to pursue his archæological studies in Egypt almost to the end. He leaves behind him a record of sound and methodical work which has not always been so widely or so fully recognised as it deserves.

News and Views

Dr. Bernard Smith and the Geological Survey

DR. BERNARD SMITH, who has been appointed to succeed Sir John Flett as director of the Geological Survey of Great Britain, joined the Survey as a geologist in 1906, became district geologist of the Cumberland Division in 1920, and was appointed assistant to the director in 1931. In 1902 he had entered Sidney Sussex College, Cambridge, where his uncle, Charles Smith, author of many well-known books on mathematical subjects, was master. Taking a first class in both parts of the Natural Sciences Tripos and gaining the Harkness Scholarship for geology in 1906, he maintained his College's fine record for producing first class geologists. The Harkness Scholarship has been won by Sidney men six times since 1893. Bernard Smith's work on the Geological Survey and his researches pursued during vacations earned him a Geological Society award in 1913 and the Bigsby Medal of that Society in 1927. He was elected a fellow of the Royal Society in 1933. He is the author of many papers on stratigraphy and on the glaciology of Cumberland and North Wales, of many contributions to the memoirs of the Geological Survey, and of a well-known textbook of physical geography. His work on the Survey, particularly on the coal and iron-ore deposits of Cumberland, has brought him into contact with practical problems in which the Geological Survey and its Museum are so closely concerned. We may congratulate him on being selected to direct the progress of the Geological Survey in the first year of the second centenary of its work, and it may augur well that the new director, chosen at this historic moment in the life of the Survey, bears the name of the "father of English Geology", William Smith.

Prof. A. P. Karpinsky and the U.S.S.R. Academy

AMONG the delegates present at the recent celebration of the centenary of the Geological Survey of Great Britain was the veteran geologist, Prof. A. P. Karpinsky, president of the U.S.S.R. Academy of Sciences, Leningrad. Prof. Karpinsky is well known to British geologists, and was elected a foreign correspondent of the Geological Society of London so long ago as 1898. He became a foreign member of the Society in 1901 and received the Wollaston Medal in 1916. He is now in his ninetieth year, and has been a member of the Academy of Sciences in Leningrad for nearly fifty years, and its president for twenty years. The honorary members of this Academy include Sir F. G. Hopkins, Lord Rutherford, Sir Charles Sherrington and Sir Robert Hadfield. At a small luncheon given by Sir Robert Hadfield on July 10 in honour of Prof. Karpinsky, at which there were present, among others, Sir F. G. Hopkins, president of the Royal Society, Prof. W. W. Watts, president of the British Association, and Sir John Flett, director of the Geological Survey, Sir Robert recalled that Faraday was an honorary member of the Academy. He added: "As a metallurgist, I can speak with the highest approval of the splendid work of the two famous Russian scientists of the past, Demetri Tchernoff, who I believe was a member of the Academy, and Sergius Kern. From the research work of both these metallurgists I greatly benefited in my younger days." After the luncheon, the guests had an opportunity of seeing some interesting exhibits brought together by Sir Robert Hadfield, including a model in modern rustless steel of the famous iron pillar at Delhi, Mr. F. J. Halnon's bronze group symbolising "A Legend of Metallurgy", and objects illustrating results of investigations of specimens of steel made by Faraday at the Royal Institution between the years 1819 and 1824 and described in Sir Robert's book "Faraday and his Metallurgical Researches".

South African Protectorates and British Pledges

MINISTERS of the Crown have shown a somewhat tardy but earnest desire to allay public uneasiness lest further steps should be taken to carry out the undertaking of the British Government to hand over the three South African native protectorates to the tutelage of the Union Government without any opportunity being given for the expression of the views of the native population on the proposed transfer. The ground for this fear has now been removed by an official reaffirmation of the pledges given when the South Africa Bill passed through Parliament. In the *aide-memoire*, which was handed to the Prime Minister of the Union of South Africa by the Secretary of State for Dominion Affairs on May 15 last, now published as a White Paper (Cmd. 4948), explicit reference is made to the undertakings that the inhabitants, both native and European, of the Protectorates would be consulted, and Parliament given an opportunity to express its views, as precedent conditions which must be observed before transfer takes place. This memorandum goes on to state that the Government has expressed its view to General Herzog that not only is the time not ripe for such consultation of the inhabitants, but also that the information at its disposal indicates that native opinion in the territories is very strongly opposed to the transfer. This statement will bring reassurance to those who have felt apprehension at the way in which the situation has appeared to be developing in the last twelve months, and also it will give them no little gratification by its firm, but at the same time conciliatory, attitude in asking for the co-operation of the Union Government with the administration of the territories during the next few years in a policy which will convince the native population that the Union Government is working with the local administration in a real and generous desire to develop and improve conditions in the territories.

Committee Against Malnutrition

THE Committee against Malnutrition has issued for publication a memorandum which has been sent to the Advisory Committee on Nutrition of the Ministry of Health. The Committee considers that the full application of modern advances in the knowledge of nutrition would effect a general raising of the standard of health comparable to that which followed the lessening of disease by the construction of an adequate system of public sanitation. It is necessary not only to provide food of good quality, in sufficient amounts, but also to ensure the correct relation between the component foodstuffs. This can only be done by allowing an appreciable margin over any minimum standard hitherto formulated: the Committee considers that there is evidence that many lowly paid and unemployed families cannot purchase enough food to allow such a margin. The purchase of foodstuffs of special value will be at the expense of the cheaper energy-producing foodstuffs; dietary studies have shown that the change over to vitamin-rich food takes place automatically with increasing income. The addition of vitamin concentrates to the diet is deprecated. The Committee recommends that the precise food values of commercial preparations should be published by the Advisory Committee on Nutrition of the Ministry of Health, and that processing and dyeing foodstuffs should be prohibited. The view is put forward that all school children should receive half a pint of milk a day and nursing and expectant mothers at least one pint, with a scale of charges on a fair income basis. The Committee also expresses the opinion that the notion of minimum diets should be condemned.

Vitamin Standards

AT the request of the Health Organisation of the League of Nations, the Board of Trustees of the United States Pharmacopœia has consented to make generally available the standard cod-liver oils, prepared for use in the United States as secondary standards for vitamins A and D. The distribution of these oils will not be made through the national distributing centres as in the case of the primary vitamin standards, but direct to individual users. They may be obtained from Mr. E. Fullerton Cook, Chairman of the Committee of Revision of the U.S. Pharmacopœia, 43rd Street and Woodland Avenue, Philadelphia, Pa., U.S.A. It should be clearly stated whether vitamin A oil or vitamin D oil is required. A charge of 2.50 dollars is made for containers holding 30 c.c. A sum to cover the cost of the quantity required should be sent by international money order with the application. The oils will be sent post paid to their destinations. These reference oils are checked each six months biologically against the international standards by at least six laboratories, and their potency should therefore be increasingly dependable. Secondary standards of vitamins A and D are of considerable importance to British users, as it has not been possible to supply the primary international standards of these vitamins in quantities sufficient to enable them to be used for routine assays.

The Hæmatopoietic Liver Substance

THE *Yorkshire Post* of July 9 directs attention to the recent isolation by Dr. H. D. Dakin, who is a former student of the Yorkshire College in Leeds, and West, of a substance effective in causing blood regeneration in pernicious anæmia; the paper describing the investigation is published in the *Journal of Biological Chemistry*, vol. 109, p. 489; 1935. The material is obtained from liver extract by precipitation with Reinecke acid; the precipitate is decomposed with the aid of dimethylaniline and the active principle afterwards purified by salting out with ammonium and magnesium sulphates and sodium chloride. It appears to be of protein nature: on hydrolysis, an aminohexose similar to glucosamine was isolated together with lysine, arginine, glycine, leucine, hydroxyproline and aspartic acid; cruder preparations also contain histidine, glutamic acid and possibly traces of phenylalanine. Pepsin hydrolyses it to a slight extent, erepsin completely though slowly. The compound produces a good reticulocyte response in cases of pernicious anæmia in doses of 80 mgm. when given by subcutaneous or intravenous injection. Dakin and West's paper indicates that a distinct advance has been made in the problem of isolating the liver principle active in pernicious anæmia.

Broadcasting and the Jubilee Naval Review

FEW events of outstanding national interest now take place unaccompanied by a broadcast commentary. The Silver Jubilee review of the Fleet by His Majesty the King provided yet another demonstration of the use and efficiency of the national broadcasting service by distributing an eye-witness account of the scene and action of the review at the actual time of the event. On this occasion, the series of broadcasts was given by two naval officers located at the foretop on board H.M.S. *Royal Sovereign*, one of the ships taking part in the review, and occupying a very advantageous position from the commentators' point of view. A short-wave portable radiotelephony transmitter installed in the *Royal Sovereign* was used for the purpose of communicating the commentary to a receiver suitably located at Southsea Castle on the mainland. The signals thus received were transmitted by land-line to Broadcasting House, whence they were distributed in the ordinary way through the National stations. The programmes broadcast included a description of the scene at Spithead on the night preceding the review, with the 160 or so ships of all classes correctly assembled in position. On the actual day of the review, July 16, separate commentaries were arranged to describe the scene when H.M. the King received the Royal Salute, and then proceeded to sail up and down the lines of battleships; and finally at night a description of the illuminations of the fleet and the firework displays was given from the vantage-point of the *Royal Sovereign*. Four microphones were employed to pick up the gun salutes, cheers of the ships' crews and other characteristic sounds. As is now usual on such occasions, suitable recordings were made of the programmes to enable these to be repeated later, particularly for the benefit of Empire listeners.

A New Subtractive Colour Film

THE Eastman Kodak Company has introduced a new 16 mm. cinematograph colour film. This is known as the Kodachrome film. It differs from many other colour films now available in that the colour effects are produced 'subtractively'. The superimposition of 'minus' colours is used to yield the final colour. For example, a blue is produced by placing a minus green (magenta) on a blue-green (minus red), green by minus blue (yellow) on a minus red and so on. This is, of course, the ordinary principle of three-colour printing, but to apply it to this process has involved the use of a film coated in three layers. Each of these layers records one of the primary colours only. The top layer is sensitive to blue and transmits only green and red; the second layer records green and transmits red, while the last layer of all records only red. The film is exposed in the ordinary way and has a sensitivity which is said to be about half that of the normal film used for black-and-white cinematography. Processing is divided into a number of separate processes: (1) Development to negative. (2) Bleaching and clearing to get rid of the developed silver. (3) Exposure and redevelopment to positive. This redevelopment is carried out with a 'dye-coupling developer' which attaches a blue-green dye to the silver produced by development. All three layers are treated indiscriminately up to this point. Then follow further stages. (4) Bleaching the two upper layers; silver chloride is formed in place of the silver in these layers and the blue-green dye in them is destroyed. (5) Exposure and redevelopment of the two upper layers with a magenta coupling developer. (6) Bleaching the top layer and destroying the magenta dye. (7) Exposure and development of the top layer with a yellow coupling developer. The pictures so formed are continuous in tone.

Spelæological Research in Great Britain

A PROPOSAL to form a central organisation for the co-ordination of research in the caves and pot-holes of Britain is to be discussed at an inaugural meeting to be held on July 27 at the Museum, The Wardwick, Derby. Among those taking an active part in forwarding the movement are Prof. L. S. Palmer (Hull), Mr. A. Leslie Armstrong (Sheffield), Dr. J. W. Jackson (Manchester), Dr. A. Raistrick (Durham), Mr. H. Brodrick (Birkdale), and Mr. C. R. Hewer (Bristol University Spelæological Society). Prof. L. S. Palmer will act as chairman of the meeting, when aims and methods which will best promote systematic exploration of British caves on comprehensive lines, embracing all relevant forms of evidence, will be discussed. The proposal most favoured at present is the constitution of a British Spelæological Association, which would lead the way to a standardisation of technique and afford opportunity for co-ordination of results. Cave exploration in Britain has by no means been neglected, as the exploration of Kent's Cavern, Torquay, and Boyd Dawkins' classic work on "Cave Hunting" bear witness. The pot-holes clubs and antiquarian societies of the north of England have devoted considerable attention to it, and the activities of the Bristol University Spelæological Society, Mr. Leslie Armstrong and Prof. Palmer have been remarkably fruitful in additions to archæological knowledge, especially of the palæolithic period. It is felt, however, that co-operation between individuals and organisations interested in the problems of cave-dwelling man and his environment will facilitate further research and preserve the enthusiasm of explorers from unprofitable, and even harmful, activity by ensuring greater uniformity in the observance of scientific methods of exploration—a view in which archæologists, at least, will heartily concur.

Lulham Memorial Fund

MISS ROSALIE LULHAM, who died on December 28, 1934, was well known as a field naturalist and for her work as a teacher of natural history. During the last year of her life she was actively concerned in planning a course of training in natural history for students, teachers and others with previous scientific training, who, to quote her own words, "wish to make that practical study of living things both outdoors and indoors, which would enable them to teach live Natural History, making it the absorbing and enlightening subject it may be". Such a course of training is being established at the Froebel Institute, where she worked for thirty-eight years, and where the tradition of her teaching is living and growing in the Natural History Department built up by her efforts. The College of the Institute at Roehampton Lane, London, S.W.15, with its spacious grounds and its proximity to Richmond Park, offers excellent scope for practical study in natural history, and it has been suggested that a Lulham Memorial Fund be opened with the object of equipping the Science Department for advanced study in natural history. We trust that this appeal will meet with ready response not only from those who, directly or indirectly, shared the inspiration of her teaching, but also from those who believe that there is a real educational need for encouraging the teaching of biology through the study of living Nature. Donations should be sent to Dr. A. B. Rendle, c/o British Museum (Natural History), Cromwell Road, London, S.W.

Television in the Cinema

CAPTAIN A. G. WEST, of the Baird Television Co., Ltd., gave a very instructive address to the Cinematograph Exhibitors' Association at Cardiff on June 26. A summary of this address appears in the *Electrician* for July 5. He pointed out that the only possible waves that can be used to produce high-definition pictures are ultra-short waves the lengths of which are not greater than 10 metres. If a 6-metre length is used, then the necessary breadth of the band need lie only between 5·9 metres and 6·1 metres. If it be operated on 300 metres, it would interfere with many of the broadcasting stations in Europe. Ultra-short waves have almost the same properties as waves of light and thus cast shadows. The transmitting aerials on the top of the Crystal Palace tower are

700 ft. above sea-level and in most directions give an effective range of transmission of about 40 miles. In his opinion, the best all-round wave-length for television is 7 metres, which does to a certain extent curve round hills to more distant points. A large number of tests have been carried out in all parts of London in receiving pictures from the Crystal Palace transmitter. Excellent pictures have also been received at some fifty sites ranging from Southend to Maidenhead and from Hatfield to Sevenoaks. In two years time, it may be possible to buy a complete set for the home for about 35 guineas. For cinema work, he thought that the best method is to use an intermediate film. A film is taken of the scene to be transmitted. It is then developed, fixed, washed and dried before being televised, the whole operation being less than two minutes. The first cinemas to receive their programmes by television would get them by radio transmission links. Later on, the big central radio transmitter might conveniently be replaced by a central distributing exchange point, which would receive the televising waves by cable from the outside point possibly twenty miles away.

Italian Breakwater Construction

On July 9, at the invitation of the Council, a special lecture, illustrated by lantern views, was delivered at the Institution of Civil Engineers, by Prof. E. Coen Cagli, of the School of Engineering of Rome. Prof. Cagli reviewed very exhaustively the progress made during recent years at Italian harbours and gave particulars of the present accommodation and equipment at the leading ports. He related how, on his recommendation, following an official visit a number of years ago to Great Britain for the purpose of studying British methods and practice, the vertical wall type of breakwater came to be adopted in Italy, and he stated that, with the exception of an unfortunate experience at Catania, attributable to absence of vertical bond in the structure, the results had been uniformly successful. He described the catastrophic storm of March 26–27, 1933, which caused the displacement of 700 lineal metres of newly constructed breakwater at that port and compared it with the similar catastrophe which befell the second arm of the Mustapha Jetty at Algiers on Feb. 2–3 of the following year (vide NATURE, **135**, 143, Jan. 26, 1935), giving it as his opinion that these two incidents, on an analysis of the attendant conditions, only served to confirm his judgment in favour of the vertical wall breakwater. This type, moreover, had received further support from a series of experimental tests with small scale models, which he had been conducting with the co-operation of Prof. Stuckey at the hydrological laboratory of the University of Lausanne. Prof. Coen Cagli closed his lecture with a statement of the series of conclusions at which he had arrived on the basis of his experimental investigations.

Foundation for Theoretical Biology at Leyden

To promote the study and work in the field of theoretical biology, a foundation for theoretical animal and human biology has been established at the University of Leyden. In memory of Van der Hoeven (1801–68), professor of zoology in the University and author of the "Philosophia Zoologica", it is called "Prof. Dr. Jan van der Hoeven Stichting voor theoretische biologie van dier en mensch". The chief objects of the foundation are: (1) to arrange for lectures at the University of Leyden; (2) to bring Leyden biologists who are interested in theoretical biology into contact with their colleagues in Holland and abroad; and to promote the co-operation of theoretical biologists all over the world, for example, by arranging international symposia on theoretical biology; (3) to publish articles on theoretical biology; (4) to found a library on this subject. The directors of the Foundation are: Dr. C. J. van der Klaauw, professor of general zoology at the University of Leyden, Dr. J. A. J. Barge, professor of medical anatomy at the University of Leyden, and Dr. Adolf Meyer, professor of theoretical biology at the University of Hamburg.

U.S. Stratosphere Balloon *Explorer II*

MISFORTUNE has attended this latest attempt at stratosphere research. An account of the careful preparations that had been made jointly by the National Geographic Society and the U.S. Army Air Corps appeared in NATURE of June 22 (p. 1026) and the largest balloon ever designed was scheduled to be ready by June 1. A message in *The Times* of July 12 reports, however, that whilst the gondola was being attached on the previous day, the balloon burst for some unaccountable reason; the 375,000 cu. ft. of helium were lost, and the five men working below had to jump for their lives to escape from the falling mass of the collapsing envelope. From the brief report it would appear as though the whole of the 8 tons upward force was too much for the initial cylindrical form assumed by the envelope, with the result that the top blew out.

The New York Aquarium

THE thirty-eighth annual report of the New York Zoological Society includes the report of the director of the Aquarium, Mr. Charles M. Breder, Jr., assistant director (June 1934). Some of the larger exhibits, including aquatic mammals, have been discontinued, but there is a larger number of fishes, so that the total number of species and specimens is greater than before. The work of the laboratory for the most part was concerned with studying various details of aquarium operation for the improvement of life conditions of fishes in captivity, including water chemistry, control of parasites and bacteria, food and breeding. A new antiseptic, 'mesthiolate', was found to be of distinct value in the control of secondary bacterial infection and in overcoming attacks of the protozoan *Costia*. Young brine shrimps, *Artemia salina*, reared from dried eggs supplied by the San Francisco Aquarium Society, have proved an excellent food for the sea-horses and other small fishes. With some little trouble, the shrimps may be raised to a considerable size suitable for larger species.

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A chemist in the Fulham Power Station—Town Clerk, Dept. 6, Town Hall, Fulham, S.W.6 (August 6).

Regius professor of zoology in the University of Glasgow—Private Secretary, Scottish Office, Whitehall, London, S.W.1.

A lecturer in physics and mathematics in the Rotherham College of Technology and Art—Director of Education, Education Offices, Rotherham.

Assistants for field and drawing-office work, Air Ministry—Secretary (W.B. 9, Room 161), Air Ministry, Adastral House, Kingsway, London, W.C.2 (by postcard).

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 110.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Artificial Radioactivity of the Rare Earth Elements

WE have now completed a preliminary survey of the Fermi effect (radioactivity produced by bombardment with neutrons) with all the elements of the rare earth group except illinium (61) and thulium (69). The results are summarised in the table below.

Z	*Element*	*Isotopes*	*Half-life*	*Relative Intensity*	*Hydrogen Effect*	*Active Nucleus*
57	Lanthanum	139	1·9±0·2 days	0·5	12	La^{140}
58	Cerium	140, 142	no activity			
59	Praseodymium	141	19±0·5 hours	0·9	—	Pr^{142}
60	Neodymium	142, 143, 144, 145, 146	no activity			
62	Samarium	144, 147, 148, 149, 150, 152, 154	*c.* 40 min. and a much longer period	0·03	—	? ?
63	Europium	151, 153	9·2±0·1 hours	19	40	Eu^{152} or Eu^{154}
64	Gadolinium	155, 156, 157, 158, 160	no activity			
65	Terbium	159	3·9±0·1 hours	0·6	—	Tb^{160}
66	Dysprosium	161, 162, 163, 164	2·5±0·1 hours	>30	20	Dy^{165}
67	Holmium	165	2·6±0·2 hours	>30	15	Ho^{166}
68	Erbium	166, 167, 168, 170	*c.* 7 min.	0·03	—	?
			1·6±0·2 days	0·3	—	?
70	Ytterbium	171, 172, 173, 174, 176	*c.* 3·5 hours	0·03	—	Lu^{176}
71	Lutecium	175	4·0±0·1 hours	1·0	—	Lu^{176}

The source of neutrons consisted of up to 400 millicuries of radon in contact with powdered beryllium, and the irradiation of the specimens was carried out in most cases in a large block of paraffin wax. The oxides of the rare earth elements were irradiated and measured as films containing about 0·3 grams/cm.^{2} and a similar film of silver oxide was irradiated at the same time. The relative intensities quoted in the fifth column of the table give a rough estimate of the activity per gram atom of the element when irradiated to saturation in the wax block in terms of the activity of the 2·33 min. period of silver irradiated under the same conditions. An entry "no activity" in the table indicates that the activity was less than 0·01 that of silver.

The most remarkable feature of the results is the intense activity produced by neutron bombardment of europium, dysprosium and holmium. These elements should prove useful as detectors of neutrons. The high activity shown by some of the rare earths makes it necessary, however, to take special care to ensure that weak activities ascribed to other rare earths are not due to the presence of a small amount of a highly active element. We have, therefore, examined in most cases specimens which on spectroscopic examination showed only traces of impurities, or specimens prepared in two different laboratories. In addition to those prepared by one of us (J. K. M.) we have used specimens of lanthana, praseodymia, neodymia and dysprosia, purchased from Messrs. Adam Hilger, Ltd., which on spectroscopic test are found to be free from other rare earths and contain only traces of other elements. We are indebted to Prof. G. Urbain for specimens of holmia, erbia and lutecia with which we have obtained the same results as with our own preparations.

We have confirmed the 19 hour period of praseodymium and the 40 minute period of samarium discovered by Fermi[1] and his co-workers but we have been unable to find an activity with an intensity greater than 0·01 on the silver scale for neodymium or for gadolinium, for which Fermi reports periods of 1 hour and 8 hours respectively. We are also unable to confirm the 5 minute period reported by these workers for praseodymium. On the other hand, we have found a considerable activity for lanthanum with a period of 2 days whilst Fermi reports that this element is inactive.

In an earlier letter[2] one of us (S. S.) reported periods of 2·9 hours for erbium and 2·5 hours for ytterbium, but the specimens examined were of doubtful purity. These results we now find are probably due to contamination with small amounts of holmium, as the purer specimens now studied give the periods quoted in the table. The erbia used in the later experiments was derived from a long series of fractionations as bromates and gave the same results as that supplied by Prof. Urbain. We have now examined a specimen of ytterbia separated from lutecia and other earths by the electrolytic method as insoluble $YbSO_4$. It gives a very feeble activity which is indistinguishable in period from that of lutecium and is probably due to residual traces of that element. The residual earths after the separation of ytterbium consisted chiefly of lutecia and gave a strong activity identical in period with that found for Prof. Urbain's specimen of lutecia.

The similarity in the periods found for the strong activities of holmium and dysprosium is somewhat curious. After the first observations had been made, the bromate fractions from which the specimens had been taken were submitted to another 1,000 crystallations and the specimens finally studied gave absorption spectra which showed that they were free from dysprosium and holmium respectively. Furthermore, specimens of dysprosia from Messrs. Hilger and of holmia from Prof. Urbain gave the same results as our own preparations.

It seemed possible that both elements might give rise to the same active product, namely, $_{66}Dy^{165}$ by the following nuclear reactions:

$$_{66}Dy^{164} + {}_0n^1 \rightarrow {}_{66}Dy^{165} \quad . \quad . \quad . \quad (1)$$

$$_{67}Ho^{165} + {}_0n^1 \rightarrow {}_1H^1 + {}_{66}Dy^{165} \quad . \quad . \quad . \quad (2)$$

Nuclear processes of type (2) in which heavy particles are emitted usually show a hydrogen effect of unity. (Fermi, loc. cit.) We have, therefore, determined the hydrogen effect for both elements and find that it is large. Reaction (2) is therefore improbable and the

similarity in the periods of the products from holmium and dysprosium must be regarded as a coincidence.

We are indebted to Imperial Chemical Industries, Ltd., for a grant which has largely defrayed the cost of this investigation.

J. K. MARSH.

Old Chemistry Laboratory,
Oxford.

S. SUGDEN.

Birkbeck College,
Fetter Lane,
London, E.C.4.

[1] Amaldi, D'Agostino, Fermi, Pontecorvo Rasetti and Segrè, *Proc. Roy. Soc.*, A, **149**, 522; 1935.
[2] Sugden, NATURE, **135**, 469; 1935.

Artificial Radioactivity of Dysprosium and other Rare Earth Elements

IN their pioneer work on artificial radioactivity through neutron bombardment, Fermi and his collaborators announced the discovery of the activity of some of the rare earth elements, namely, of lanthanum, praseodymium, neodymium, samarium and gadolinium. Recently, Sugden[1] found that terbium shows an appreciable, and europium a very strong, radioactivity after bombardment with neutrons. We find that dysprosium shows an unusually strong activity due to $_{66}Dy^{165}$ under the action of slow neutrons; so far as we can ascertain, it is the strongest activity found hitherto. So little as 1/100 mgm. of dysprosium gives an easily detectable radioactivity after bombardment with neutrons from a source containing a few hundred millicuries of radium emanation.

As dysprosium is one of the most abundant yttrium earths, it will be present in detectable amounts in many preparations of such earths, and care must, therefore, be taken in interpreting the results of the activation of the elements of the yttrium group. One of the holmium preparations investigated was, however, found to be practically free from dysprosium, and decayed with a period of 35 hours. We find that erbium decays with a period of 12 hours, ytterbium was found to have a half-life value of 3·5 hours*, while lutecium decays much slower, having a period of about 5 days.

The periods and relative intensities of the rare earth elements 59–71 (praseodymium – lutecium) are seen from the following table, which also includes a

Element	Half-life	Relative Intensity	Half value thickness (in cm.)
59 Praseodymium	19 h[2]	4·5	0·045[2]
60 Neodymium	1 h[2]	0·04	
62 Samarium	40 m[2]	0·6	
63 Europium	9·2 h[1]	39	0·04
64 Gadolinium	8 h[2]	very low	
65 Terbium	3·9 h[1]	2·5	
66 Dysprosium	2·5 h	100	0·025
67 Holmium	35 h	20	0·04
68 Erbium	12 h	0·35	0·03
70 Ytterbium	3·5 h*	0·25	0·04
71 Lutecium	about 5 d	about 1	
47 Silver	2·3 m	8	0·03

comparison of the intensities obtained when the preparations were activated until the maximum activity under the action of neutrons slowed down through the presence of large blocks of paraffin wax. The table contains also the half-value thickness in aluminium of the β-rays emitted.

We find for the upper limit of the continuous β-spectrum of dysprosium an energy of $1{\cdot}4 \times 10^6$ e.v. and for that of holmium $1{\cdot}6 \times 10^6$ e.v. The activity of dysprosium obtained through the action of fast neutrons was only 1/100 of that measured in the presence of paraffin wax, Fermi's coefficient α being thus 100, while in the case of holmium we find $\alpha = 20$. The rare earth preparations investigated were given to us by the late Baron Auer von Welsbach.

G. HEVESY.
HILDE LEVI.

Institute of Theoretical Physics,
Copenhagen.
July 1.

* The weak activity observed is possibly partly due to the presence of traces of dysprosium; investigating a commercial preparation of ytterbia, Sugden (l.c.) found a period of 2·9 hours.

[1] S. Sugden, NATURE, **135**, 469; 1935.
[2] E. Fermi, E. Amaldi, O. D'Agostino, F. Rasetti and E. Segrè, *Proc. Roy. Soc.*, *A*, **146**, 483; 1934.

Enzyme Catalysis of the Exchange of Deuterium with Water

IN a further study of this reaction[1], we have found that the (first order) velocity constant depends markedly on the pressure of the hydrogen, being in fact inversely proportional to the square root of the pressure.

Sets of simultaneous measurements were made (at 37°) using equal samples of the same washed bacterial suspension (Bact. Acidi Lactici) so that all conditions could be made identical except the pressure.

The results of two typical sets are shown in Fig. 1, where the logarithm of the final deuterium concentration in the gas (C) is plotted against $p^{-1/2}$, that of the initial concentration (C_0, common to the set) being plotted on the axis ($p^{-1/2} = 0$).

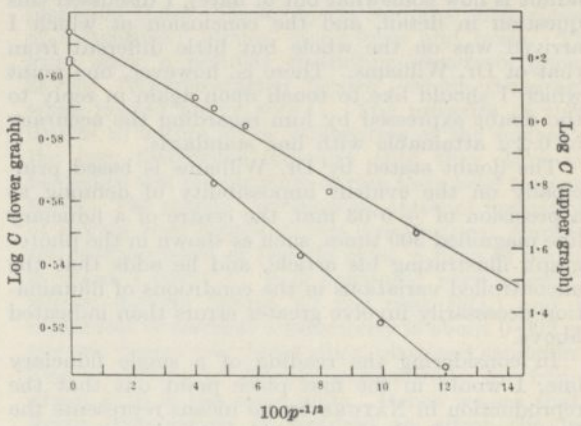


Fig. 1.

In these two sets, the number of bacteria present happened to be practically the same (8×10^{11}) but the times of reaction (t) were respectively 1212 min. (upper set) and 180 min. (lower set). The graphs, therefore, correspond to the equation

$$\log C_0 - \log C = Ktp^{-1/2} \qquad (1)$$

where K has the values 0·0047 and 0·00453 respectively.

It was found in all cases that, during the course of the reaction, the number of living bacteria, as

shown by the viable count, was diminishing rapidly (half-life period two to three hours), but this does not appear to affect the catalytic power. In fact, experiments made with the same suspensions after these had been kept for six days yielded practically the same value for the velocity constant.

A similar lack of correlation between enzyme activity and viability has been observed in the case of oxidative mechanisms[2].

From equation (1) we conclude that, as in the analogous case of metallic catalysts for which the same dependence on pressure has been established[3], the reaction takes place in two stages :

$$HD + 2B \rightleftharpoons HB + DB,$$
$$DB + H_2O \rightarrow HB + DHO,$$

(where B represents a catalytic 'centre') of which the second is much the slower and, therefore, the rate-determining stage.

We are attempting to estimate the rate of the first stage reaction also, by the use of parahydrogen and the $D_2+H_2 \rightarrow 2HD$ reaction.

G. H. BOTTOMLEY.
B. CAVANAGH.
M. POLANYI.

University of Manchester.
June 19.

[1] Observed independently by Farkas, Farkas and Yudkin, *Proc. Roy. Soc.*, B, **115**, 373; and by Cavanagh, Horiuti and Polanyi, NATURE, **133**, 797; 1934.
[2] M. Stephenson, *Ann. Rev. Biochem.*, **2**, 488; 1933.
[3] Horiuti and Polanyi, *Proc. Manchester Lit. and Phil. Soc.*, **78**, 50; 1934.

Precision of Line Standards

DR. W. EWART WILLIAMS has recently published in NATURE[1] an interesting article on "Light-Waves as Units of Length". In a memorandum entitled "Les idées actuelles sur la définition de l'unité de longueur"[2], which appeared in 1927 (and which I admit is now somewhat out of date), I discussed this question in detail, and the conclusion at which I arrived was on the whole but little different from that of Dr. Williams. There is, however, one point which I should like to touch upon again in reply to the doubt expressed by him regarding the accuracy of $0{\cdot}2\,\mu$ attainable with line standards.

The doubt stated by Dr. Williams is based principally on the evident impossibility of defining to a precision of $\pm\ 0{\cdot}03$ mm. the centre of a fiduciary line magnified 300 times, such as shown in the photograph illustrating his article, and he adds that the uncontrolled variations in the conditions of illumination necessarily involve greater errors than indicated above.

In considering the reading of a single fiduciary line, I would in the first place point out that the reproduction in NATURE by no means represents the appearance of a line as seen through the microscope of a comparator. The photograph was taken at a frontal distance of about one millimetre. The illumination was by means of a prism and therefore strongly tilted in the direction of the line, which exaggerates its defects. In the second place, it is not the centre of the line that is read, but its axis, viewed by symmetrical setting between the two threads of the micrometer situated on either side. The evaluation of the two boundaries of the line, in conformity with the definition recently laid down in detail for line standards, is much more precise than the reading of the centre. Finally, as to the effect of the lateral inclination of the light beams, the experiments of MM. Volet and Bonhoure[3], in which the source of light is moved systematically to the utmost extent first to the right and then to the left of the same line, have not occasioned apparent displacements greater than $0{\cdot}6\,\mu$. The possible uncertainty due to a faulty adjustment of the illumination cannot therefore exceed a very small part of this maximum. I would add that the line reproduced in the illustration is the worst line, given by way of example, of the worst of our old prototypes, bar 26, which has been in constant use for forty-six years. The addition several years ago of a more recent prototype to the working standards of the International Bureau has prepared the way for its withdrawal.

It must not be forgotten, however, that the reading of a line viewed separately has no significance whatever. Each bar has two similar lines, traced consecutively by the same tool on surfaces polished in the same way and cut in the same manner. Must not any systematic error in the viewing of lines be eliminated for a double reason ? The two lines are seen under microscopes similar in all particulars ; and the bar is intended to serve only in comparison with another bar read by the same observer under the same microscopes provided with the same illumination.

Moreover, the evaluation of a bar is not determined by one reading of the lines in a single position of the bar. A series of comparisons with another bar includes twelve observations, six on each bar in turn, each observation being the mean of two readings. Eight series are executed, including every symmetrical position of the bar with regard to the comparator and consequently to the illumination (which remains fixed) and to the observer. For all major comparisons, many other checks are taken advantage of by comparisons with other bars which are taken in groups of five or six, in all possible combinations two by two, so that finally the value attributed to a bar is the result of not less than five hundred readings of each of its lines. Those who are prepared to accept the result of the calculation of probabilities applied to metrology may deduce therefrom that it is sufficient to make each duplicate reading of a bar with a precision twenty times less, that is, about $4\,\mu$ for a double reading of the bar itself, or, if one makes use of a magnification of 300, then something less than a millimetre. Even by making use of the photograph reproduced in the article, similar reasoning (in which, however, I have little confidence) would lead to a higher degree of accuracy than $0{\cdot}2\,\mu$ for the evaluation of a line standard.

It is always interesting to seek for explanations of facts and I have not failed to do so. But the true answer to the doubt expressed by Dr. Williams is the direct affirmation of experience. It is found in practice that a line-bar of good quality compared with a group of others reproduces the same value, whatever may be the experimental conditions and whoever may be the observer, with a precision of $\pm\ 0{\cdot}2\,\mu$. This evaluation of accuracy is that of the strictest metrologists, among whom I number myself. There are metrologists, not without distinction, who would accept a still more favourable evaluation[4].

It remains now to explain the discrepancy pointed out by Dr. Williams, of 0·0036 A. between the value of the cadmium red wave-length as determined by the Reichsanstalt and by the National Physical Laboratory. If as he thinks probable, this

difference arises from the initial comparison of the national prototypes with the Sèvres working standards, it would correspond to an error of 0·56 μ between the British and German prototypes. But this supposition has recently been shown to be unfounded. The prototype No. 16 of Great Britain and No. 18 of Germany have since been returned to Sèvres, and with the obliging collaboration of a metrologist from the N.P.L., have been very carefully compared one with the other. The result showed, within about 0·06 μ, the same difference that we attributed to them previously.

ALBERT PÉRARD.

Sèvres.
May 24.

[1] NATURE, **135**, 459 and 496; 1935.
[2] "La Création du Bureau international des Poids et Mesures et son Œuvre". Paris: Gauthier-Villars, 1927, p. 259.
[3] "Procès-Verbaux des séances du Comité international des Poids et Mesures", Deux. série, **15**, 30; 1933.
[4] See Ch.-Ed. Guillaume, "Les Récents Progrès du Système métrique", pp. 14 and 15; 1934.

M. PÉRARD'S justification of the metrologist's claim of being able to compare two line standards with an error not exceeding ± 0·2 μ is based entirely on the degree of concordance observed in practice when large numbers of readings are taken in all possible positions. Equally so, we find when we analyse the purely interferometric data for the number of waves contained in an optical gauge of a metre length, the concordance between the individual results is even more striking.

Michelson has expressed the opinion[1] that if the standard metre had been an optical gauge instead of a line standard, the accuracy of the wave-length determination could be increased five-fold. Sears and Barrell[2] estimate that the overall probable error associated with the optical measurement is ± 0·016 μ, while the average accuracy of repetition in the measurement of line standards is taken to be of the order of ± 0·25 μ.

Unless the difference between the values of Kösters and of Sears and Barrell can be ascribed to uncertainties regarding the lengths of the line standards, one is driven to the conclusion that the discrepancy is due to a lack of symmetry in the hyperfine structure of the red cadmium source. With such asymmetry, the value obtained for the wave-length is an oscillating function of the path difference in the interferometer. This effect is much more pronounced with the Michelson instrument, or the Twyman and Green modification of it as used by Kösters, than with the Fabry-Perot interferometer employed by Sears and Barrell. The higher the effective number of reflections, the more closely does the interference fringe correspond to the real intensity distribution of the spectral line itself. Sears and Barrell used plate separations of 1/12th and 1/9th metre as basic units and were not able to detect a measurable difference in the wave-length value.

Hence, in spite of M. Pérard's assurances, there still remains the possibility that the experimental error in line standard comparisons may in reality be two or three times larger than his estimate.

W. EWART WILLIAMS.

King's College,
Strand, W.C.2.
June 18.

[1] "Studies in Optics," p. 54.
[2] *Phil. Trans.*, **233**, 173; 1934.

Origin of Tektites

GLASSY particles weighing between approximately a gram and occasionally a hundred grams have been found at several widely separated places on the earth's surface. The explanation of the origin of these natural glass particles, known as tektites, is complicated by the series of peculiar forms which they exhibit and the size of the areas over which they are found. They have been collected from each of the States in Australia, and because of this continental distribution are frequently called Australites. Several theories of their origin have been advanced and discussed in NATURE, vols. 131 and 132, 1933. Dr. L. J. Spencer and others suggest that the tektites are 'aerial fulgurites', the post-impact result of a great meteorite striking the earth in a region of sandstone or desert sand. Comparison is made with the silica-glass from the meteor craters at Henbury and Wabar. The main difficulty in accepting their theory is the wide distribution of the particles wherever they are found. The W. H. C. Shaw collection of Australites was made over a region of 30,000 square miles on a "monotonous limestone plain" on the southern shore of Australia[1]. Furthermore, Fenner points out that the region is "without any siliceous rocks whatever"; hence a fulguritic origin for these Australites appears to be impossible.

Another theory assumes that they were originally extra-terrestrial bodies and that at the time of a meteoritic passage through the earth's atmosphere they became liquid from the frictional heat (Michel, Suess, and others)*. As they cooled, the combination of air resistance and some rotational motion of their own caused them to take on the lens, tear-drop, or dumbbell shapes which are observed[2]. There are several theoretical difficulties with the possibility of such a shaping process, as well as the observational objections discussed below.

There are numerous bodies which are known to have descended through our atmosphere from interplanetary space. These objects comprise three classes of meteorites: stones, stony-irons and irons. The irons show a peculiar crystalline structure, known as the 'Widmanstätten figures', which disappears when heated above 850° C. The presence of these figures to within a few millimetres of the surface of the iron meteorites indicates that they were not heated to this temperature during their brief meteoric flight. The stones also show no internal indications of having been heated to this temperature. Further, the melting point of Darwin glass, a form of tektite, is about 1,400° C.[3]; it is composed very largely of silicon dioxide (about 87 per cent SiO_2) and its coefficient of thermal conductivity is about 0·002 cal. per cm. degree sec. (fused silica, glass and sandstone). The coefficient of thermal conductivity for iron is about 0·10 in the same units. Hence we see that a lower temperature is required to affect the iron meteorites than to melt the tektite, and that the rate of heat transfer is about fifty times greater for the iron meteorite than for the tektite; yet the iron meteorites give no evidence of having been heated to an internal temperature† of 850° C. It therefore

* The combustion theory of Lacroix appears artificial; the reaction suggested probably could not occur during a meteoric flight, as the meteoric phenomenon is now interpreted.

† A low internal temperature for iron meteorites in flight through the atmosphere is assumed as the result of the 'ablation' (liquification and immediate removal) of the heated surface. This process is generally believed to absorb most of the heat of the atmospheric resistance[4]; freshly fallen meteorites are seldom described as being more than "milk warm".

appears impossible that sufficient heat from atmospheric friction was transferred to the interior of the tektites to allow them to melt and take on the observed shapes.

For the reasons given above we consider that, as yet, no satisfactory meteoritic theory has been advanced to explain the origin of tektites.

FLETCHER WATSON, JR.

Harvard College Observatory,
Cambridge, Massachusetts.
June 10.

[1] C. Fenner, "Australites", Part 1. "Classification of the W. H. C. Shaw Collection", *Trans. Roy. Soc. South Australia*, **58**, 63 and 64; 1934.
[2] A. Lacroix, "Les Tectites de L'Indochine", Extract of the *Arch. Muséum National d'Histoire Naturelle*, 6ème Ser., **8**; 1932. C. Fenner, *op. cit.*, pp. 62–79.
[3] A. Lacroix, *op. cit.*, p. 211.
[4] W. J. Fisher, Harvard College Observatory Circular, 385, 1934.

Philosophy and Modern Science

I AM sorry if my psychological knowledge fails to reach the standard required by Dr. Dawes Hicks[1]. My book[2] has, as a matter of fact, been the subject of favourable notice in three psychological journals, though I cannot claim the universal agreement that would apparently be necessary to make it convincing to Dr. Dingle. I have done my best to explain what I mean by the terms used.

What Dr. Dawes Hicks calls a 'sensum' seems to be what Russell called a 'sense-datum'; and I do not use sense-data, partly because most of the alleged existing sense-data are not perceived and therefore are not part of our fundamental knowledge, and partly because some inference and refinement are necessary before we can pass from our immediate knowledge to even the perceived sense-data. I am not sure whether I accept Dr. Hicks's other definition; his words 'mental act' seem to presuppose that we know what we mean by mind and that there is some kind of activity in merely having a sensation; the former seems to me to be posterior, not anterior, to sensation, and the latter is I think untrue. When my eyes are open I am aware of various patches of different shapes and colours, which disappear when my eyes are closed. Those are what I mean by a sensation. They seem to be immediate and not the result of any activity on my part; they just happen. In the case of sensations of sound even the minor preliminary activity of opening my eyes is unnecessary.

Again, Dr. Hicks's definition of a concept presupposes the existence of universals, and apparently denies the existence of different degrees of universality. Here I definitely disagree. A single observation of Neptune is merely a bright spot surrounded by blackness, with appropriate modification in the case of a photographic observation. It is only when many observations are available that we can form the idea of a single body moving in a definite way; generalisation has already been applied in thinking of Neptune at all. The individuals are merely a certain finite number of bright spots.

I am quite clear that I do not experience another person's sensations. He can tell me about them, and I may believe what he says; but a long process of inference has been involved before I can attach a meaning to this statement and put them on a similar footing to my own. It is well known to astronomers that the observations of different observers need certain corrections before they become comparable among themselves.

I agree with Dr. Campbell's second paragraph; I should also agree with his first if I was sure that he does not regard my view as a philosophy. I regard it as a description of the method of acquirement of knowledge. For example, what I call a concept is substantially what Pearson called a construct; but I prefer not to use the latter term because it suggests acceptance of the phenomenalist philosophy, while I think that there is nothing in my work that could not be equally well accepted by a critical realist.

Though I do not necessarily agree with Prof. Levy entirely, I consider him clearly right in objecting to Prof. Dingle's adoption of universal agreement as a fundamental criterion while trying to maintain a critical attitude about the reality of the external world, since other people are part of that world. My own opinion is that both are inferred from much more fundamental data.

HAROLD JEFFREYS.

St. John's College,
Cambridge.

[1] NATURE, **135**, 1035, June 22, 1935.
[2] "Scientific Inference", 1931.

DR. NORMAN CAMPBELL is so far right that in the philosophical interpretation of science conceptions about reality and existence lie at the very core of the matter. To me, these are primaries and indefinables. They can be explained only in terms of human practice; that is to say, again only in terms of the active side of reality and existence. The 'logical network' view cannot embody in its scheme this activist side of reality, for it is basically static and contemplative in character and purpose. A social philosophy of science, on the other hand, automatically makes man's capacity for changing the world an integral part of its story. The purpose of the philosophy is both conscious and dynamic.

It is for this reason that Mr. C. O. Bartrum[1] misses the point when he argues that the difference between the two views is merely one of words. The extent to which words may indeed arouse confusion is apparent when Mr. Bartrum quotes me as saying "that the man of science should be responsible for the social consequences of his work" and when he pictures the terrifying results that would follow in every laboratory if this were accepted. What I actually wrote was that my view keeps "the scientist alive to the social consequences". There is an ocean of difference between the two statements.

H. LEVY.

Imperial College of Science,
South Kensington, S.W.7.

NATURE, **135**, 1036, June 22, 1935.

Origin of Man Again?

THE controversy on "Special Creation and Evolution"[1] continues to recur periodically in spite of the fact that it has long been known to scholars and learned Kabbalists that the Biblical narrative of *Genesis* is a representation of Chaldean allegories. To-day in many branches of science, writers can expound their knowledge for the uninitiated only by means of similes, metaphors and analogies; and yet it is still the practice to translate and interpret

ancient writings and glyphs literally and in terms of our present-day ideas, hypotheses and preconceptions.

Tentative theories and schools of thought are multiplying owing to the complexities revealed in recent years by researches in all departments. In a valuable summary of current opinions on the origin of species[2], Prof. J. Ritchie referred to "the minimum that different types of mind are prepared to allow in order to bridge the gulf of scientific analysis". It is evident that the synthetic function of the mind will not give birth to a new synthetic generalisation just yet; but the wider the search for an embryonic hypothesis the sooner will one be found that is workable and acceptable to the majority.

Evolution is a fundamental cosmic principle in all ancient philosophies; but it is conceived as a *dual process of involution and evolution operating in spiral cycles*. The creative energies of Nature are *serial emanations* or 'rays' symbolised by numbers, glyphs and geometrical ideographs. While the explanation of the evolution of species (*cf.* the *Purānas* and *Vedas*) is similar to the Darwinian theory of Western science, that given for the origin of man is different.

In "The Descent of Man"[3] there is a passage on hermaphrodite forms which shows how near Darwin came to postulating a primeval androgynous stem from which, according to ancient teachings, the mammals sprang.

Briefly, in the Eastern Aryan philosophy:

(1) Each *genus* has its own 'primordial' and distinctive 'form'; and these ethereal prototypes are gradually precipitated contemporaneously with the condensation of the globe.

(2) They had become semi-physical colloidal forms of bi-sexual animals in the early Secondary Age, and were fully consolidated physiologically, and sexually differentiated during the Jurassic period. Man preceded most of the mammals.

(3) The evolution of species, races and variations was subsequent to the complete physicalisation of the tenuous colloidal forms.

This 'hypothesis', of course, "simply pushes the problem back to"—another *state*! But the phenomena of 'periodical precipitation' and of colloidal states had not been investigated in Darwin's time. To-day we are accustomed to seek for 'causes' and 'origins' in imperceptible states.

W. W. L.

[1] NATURE, **135**, 987, June 15, 1935.
[2] NATURE, **132**, 506, Sept. 30, 1933.
[3] "The Descent of Man", second edition, p. 161.

Alchemy and Music

THE supposed connexion between alchemy and music is much older than the sources quoted by Prof. Read[1]. A treatise in the "Collection" of Greek alchemists[2] deals obscurely with this subject, and it has been the object of an interesting study by Prof. Stephanides, of Athens[3]. The ultimate source is, of course, the "Timaeus" of Plato, in which the compositions of materials are explained as due to mysterious 'harmonies'. Plato was in later life much influenced by Pythagorean schools, as has been shown by Frank[4]. He was obsessed by the idea that mathematics is in some way or other the ultimate reality, and that Nature must be explained by mathematical laws, or even Nature *is* these mathematical laws. In this he seems surprisingly 'modern', or rather, modern views seem surprisingly Platonic. Most of the ideas of later alchemy are merely more or less denatured versions of the theories of the Greek alchemists, and if the music was intended for performance during the practical operations this may also be an old ritual.

J. R. PARTINGTON.

Wembley.

[1] NATURE, **135**, 967; 1935.
[2] Berthelot, "Collection des Alchimistes Grecs", **2**, 421.
[3] Μουσική καὶ Χρυσοποιία, in 'Επετηρις τῆς 'εταιρείας τῶν Βυζαντινῶν σπουδῶν, **4**, 39–45 (Athens, 1927). Hammer-Jensen, "Die alteste Alchymie", *Kgl. Danske Vidensk. Selskab., Hist.-filol. Meddel.*, **4**, ii, 144 (1921)—'sie ist von Interesse hinsichtlich der byzantinischen Kirchenmusik'.
[4] "Plato und die sogennanten Pythagoreer", Halle, 1923.

THE lecture concerned dealt exclusively with certain aspects of seventeenth century alchemy, and Maier's musical compositions of 1618 may perhaps be taken as the last and most definite attempt to associate alchemy with music. Prof. Partington's early references are very interesting.

JOHN READ.

St. Andrews.

Breeding of *Loris* in Captivity

THERE is no record of *Loris* having been bred in captivity, so it seems worth recording that one was born in my collection recently.

This animal is well known to be difficult to keep alive in confinement, and in the hands of most persons who have kept them they live only two to three months. As the period of gestation appears to be longer than this, it is not surprising that breeding has not occurred, though several instances have been recorded[1] of babies having been born to females already pregnant at the time of their capture.

Upwards of fifty individuals of the genus have now passed through my hands, and I have been successful in keeping them alive in confinement for varying periods. Some still alive have been in captivity for more than two years. The Mysore loris (*L. tardigradus lydekkerianus*) appears to stand confinement better than the Ceylonese races.

In April 1934, on leaving Ceylon on furlough, I left my collection in the charge of Dr. L. Nicholls, Government bacteriologist. In one cage were a number of specimens of the loris *L. t. tardigradus*, and in the same month was added a full-grown male of the northern race, *L. t. nordicus*. I noticed that, at the time of handing over, all the males had their testes fully descended, whereas previously their scrota had been empty. The descent in some of the males took place over-night.

All the lowland lorises in the cage mentioned died in my absence, except one female. She was evidently impregnated by the northern male in the latter part of 1934. Dr. Nicholls informs me that no copulation was observed. A baby was born on April 24, 1935. I noticed a few days later that the father had his testes descended again.

It seems out of the question for the pregnancy to have occurred as a result of the rutting activities of the male in April 1934, as this would give a pregnancy of nearly a year. It seems much more likely that the male has a testicular descent twice a year as suggested by Narayan Rao[2], and that the pregnancy dated from a rutting season in or about September or October 1934.

Although the full evidence cannot be discussed here, it would seem that *Loris* in its breeding habits

differs from its nearest relative, *Nycticebus*, and also from *Tarsius*, both of which breed continuously, and agrees with *Lemur* in having a well-demarcated bi-annual breeding season[3]. It would also appear that the gestation period is somewhere in the neighbourhood of six months—a very long period for so small an animal. This time, however, is supported by the evidence of a very long lactation period as already reported by me[4].

W. C. O. HILL.

Anatomy Department,
Medical College,
Colombo.
May 28.

[1] Pearless, S. H., *Spolia Zeylanica*, **6**, 134; 1909.
[2] Narayan Rao, C. R., *J. Bombay Nat. Hist. Soc.*, **33**, 206–209; 1937.
[3] Zuckerman, S., *Proc. Zoo. Soc.*, 1059–1075; 1933.
[4] Hill, W. C. O., *Ceylon J. Sci.*, B, **18**, 89–132; 1933.

Chemistry of Œstrogenetic Substances

As reported previously, unsaturated fat-aromatic α-ketonic acids injected into spayed mice give rise to the appearance of cornified cells in the vaginal smears[1]. Contrary to these results, J. W. Cook and E. C. Dodds failed to see an œstrogenetic effect with benzal-pyruvic acid and fural-pyruvic acid on spayed rats[2].

The total doses required for spayed mice are 24 mgm. dry sodium salts given in three doses at intervals of 24 hours. Cook and Dodds, working on rats, used doses of 100 mgm. (Calculated according to Parkes and Dodds[3], 240 mgm. would be the corresponding doses to produce œstrus in rats.) Their doses, therefore, were insufficient. Furthermore, they space the single injections of these substances in such a way that even a total amount, otherwise active, would be inactive under these conditions. "The importance of spacing the injections at the correct intervals cannot be over-emphasised." (Cook, Dodds *et al.*)[4]

The œstrogenetic effect of benzal-pyruvic acid and fural-pyruvic acid on spayed mice has been observed independently elsewhere. The statement that the œstrogenetic activity of unsaturated fat-aromatic α-ketonic acids is of the order of 1-keto-1.2.3.4.-tetrahydrophenanthrene is correct. It is known that figures of the same order are not necessarily identical figures.

E. FRIEDMANN.

Sir William Dunn Institute of Biochemistry,
University, Cambridge.
June 12.

[1] E. Friedmann, NATURE, **135**, 622; 1935.
[2] J. W. Cook, E. C. Dodds, NATURE, **135**, 959; 1935.
[3] A. S. Parkes, E. C. Dodds, quoted from E. C. Dodds, *Lancet*, 1, 935; 1934.
[4] J. W. Cook, E. C. Dodds, C. L. Hewett, W. Lawson, *Proc. Roy. Soc.*, *B*, **114**, 280; 1933.

Carotid Gland of the South African Bullfrog

THE physiological and histological studies of Heymans[1], de Castro[2], Koch[3] and others have clearly shown the great importance of the sinus caroticus in the control of circulation and respiration in mammals. The carotid nerve, which arborises in the adventitia of the sinus, is innervated by the internal pressure of the blood, and the heart-rate and respiration are reflexively affected.

Except perhaps for its absence in a few species, for example, *Ichthyophis*, the carotid gland is very characteristic of amphibians. It is also present in *Breviceps*, which never takes to water. It may therefore be profitable to study it in the light of the works on the carotid sinus in mammals.

The carotid gland of a full-grown *Pyxicephalus adspersus* is approximately 2·5 mm. in length and 1·5 mm. in breadth. Its size allows of macroscopic dissection, while on the other hand it is small enough to be fixed entire for histological dissection and staining. A series of longitudinal sections supplemented by a series of transverse sections show the following: Soon after its entrance into the swelling, the common carotid artery is seen to communicate by means of several openings with two fairly large vessels, which join and leave as the external carotid artery. The openings may also be seen in a longitudinal macroscopic dissection of the 'gland'. Somewhat deeper in the swelling, the lumen of the common carotid expands, but eventually breaks up into a network of arterioles. These again unite to form a flattened lumen, which, however, becomes more arterial and leaves as the internal carotid artery.

Several interesting points may be noted. Melanophores occur abundantly in the network, while groups of cells are distributed in it which are very reminiscent of nerve cell bodies. Silver staining will be resorted to in order to detect nerve fibres if present. Histologically the carotid gland is a very much elaborated artery. Compared with that of the sinus caroticus in mammals, its media is very thick and traversed by many elastic fibres. The carotid gland will therefore not allow of passive dilation to the extent that the sinus caroticus does. Constriction of the carotid glands in the etherised frog registered no notable change in the frequency of the heart-beat.

Suggestions as to the probable function of the carotid glands in the frog are reserved at this stage of the study.

G. ELOFF.

Department of Zoology,
University of the Witwatersrand,
Johannesburg.
June 6.

[1] Heymans, Bouckaert and Regniers, "Le Sinus Carotidien", Paris, 1933.
[2] De Castro, *Trav. Lab. Rech. Biol.*, 1928.
[3] Koch, "Die reflektorische Selbsteuerung des Kreislaufes", Dresden and Leipzig, 1931.

Forces of Attraction of Homologous Loci and Chromosome Conjugation

A SERIES of genetic and cytological data show that chromosome conjugation at meiosis is caused by the attraction of homologous parts.

A study of chromosome behaviour in heterozygous inversions has disclosed with special clearness the action of these forces. We have obtained a stock of *Drosophila melanogaster* possessing attached *X*-chromosomes, one of which had an inversion involving almost the whole chromosome. If the forces of attraction of homologous loci are sufficiently great to overcome conjugational difficulties, which are connected with heterozygous inversions, chromosome conjugation ought to take place as in Fig. 1 (left hand). In this case ring chromosomes would form as a result of a single crossing-over in an inverted region. On the left end of the *X*-chromosome, these ring chromosomes would have a small deficiency and on the right one a duplication. The stock with

attached X-chromosomes obtained by us gave a progeny, part of which in fact contained a ring chromosome (Fig. 1 (right hand), Stern's culture $xy'\ y''$).

The frequency of single crossing-over (number of distal recombinations) had at the same time not decreased. Here, too, in all the one hundred per cent of ovocytes, the same as under normal conditions, the X-chromosome undergoes crossing-over and forms at least one chiasma.

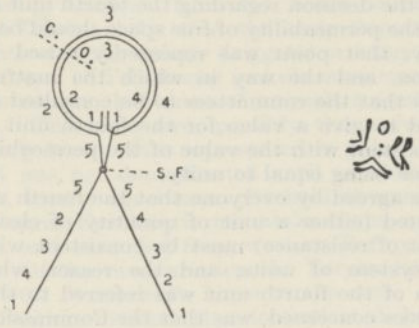


FIG. 1.

A study of double crossing-over in a similar heterozygous inversion sc^8 (non-attached X-chromosomes) has shown that the difference between the frequency of double cross-overs in a heterozygous inversion sc^8 and that of double crossing-over in a homozygous one, may be explained by the occurrence of new regional differences during ring conjugation. The increased percentage of non-disjunctional males and females which arise in a heterozygous inversion are a result of double crossing-over. Experiments show that the increase of double crossing-over in a heterozygous inversion causes an increase of the number of exceptional individuals. The presence of the latter cannot therefore prove the disturbance of chromosome conjugation.

The data obtained by us in this work indicate that in a heterozygous inversion of *Drosophila*, chromosome conjugation occurs in the same way as has been described by McClintock for *Zea Mays*. There the forces of attraction of homologous loci which bend the chromosome into a ring cause complete conjugation, notwithstanding the presence of an inversion in one of the chromosomes.

The existence of a *Drosophila* stock with attached X-chromosomes where ring chromosomes are permanently formed, is a new cytogenetic proof of Morgan's theory of crossing-over.

B. N. SIDOROV.
N. N. SOKOLOV.
I. E. TROFIMOV.

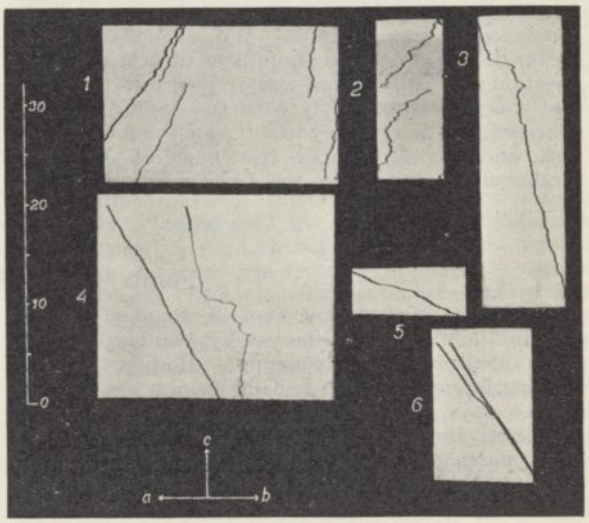
Department of Genetics,
Institute of Experimental Biology,
Moscow.
May 7.

Cosmic Ray Bursts in Liquid Dielectrics

BURSTS of ionisation produced by cosmic rays have been studied up to now in large ionisation chambers filled with a gas at high pressure. We found it advantageous to use for this purpose ionisation chambers filled with a very carefully purified liquid dielectric.

A series of preliminary observations was made with the use of a cylindrical condenser having a capacity of nearly 1 litre containing hexane (C_6H_{14}); the interior armature was an empty cylindrical vessel. The conductivity of the hexane was as low as $2{\cdot}3\times 10^{-19}\ \Omega^{-1}$ cm.$^{-1}$. In most cases a difference of potential of 1,800 volts was applied; such a considerable field was necessary in view of the small mobility of ions in a dielectric liquid (mean value in hexane[1] is 5×10^{-4} cm./sec. per cm./volt).

The armature receiving the charge was connected with a quadrant electrometer of common pattern. It recorded the gradual charging of the system by the spontaneous current in the liquid. Bronson resistance was used for compensating this current. Bursts provoked sudden deviations of the electrometer needle and corresponding displacements on the curve of the record. It was possible easily to recognise bursts supplying more than 3×10^6 ions (the actual number of ions produced was considerably greater in consequence of the loss by recombination).



To characterise the phenomenon we give two numerical results and reproductions of some records obtained[2]. In an unprotected ionisation chamber, the number of bursts was 2 in 11·7 hours. In the most favourable case, the chamber surrounded by lead blocks 5 cm. thick and the aluminium cylinder put into the interior armature, the number of bursts increased to 37 in 13 hours.

In the accompanying illustration are reproduced the records of some typical bursts: Nos. 1, 2, 3 are simple bursts; Nos. 4, 5 seem to be double bursts; No. 6 is of more complicated structure. The arrows indicate directions of deviations of the electrometer needle due to (*a*) compensating currents, (*b*) residual, and (*c*) the direction of movement of the sensitive film. On the left is a time-scale in minutes, which enables a rough estimate to be made of the duration of the bursts.

C. BIAŁOBRZESKI.
I. ADAMCZEWSKI.

Institute of Theoretical Physics,
Warsaw.
May 28.

[1] One of us has recently made a detailed study of the mobility of ions in liquid paraffins: I. Adamczewski, *Bull. Int. Acad. Polonaise*, **217**; 1934. The existence in these liquids of three sorts of ions of different mobilities was discovered.

[2] More details will be given in a paper appearing in a forthcoming issue of *Bull. Int. Acad. Polonaise.*

Electrical Units and the I.E.C.

PROF. E. W. MARCHANT, who was one of the British representatives at the recent meeting of the I.E.C. at Brussels, has sent me an account of the proceedings in connexion with the proposed introduction of the M.K.S. system, which he authorises me to publish. I should be greatly obliged if space could be found for it in NATURE.

R. T. GLAZEBROOK.

Laboratories of Applied Electricity,
University of Liverpool.
July 9, 1935.

DEAR SIR RICHARD GLAZEBROOK,

Dr. Rayner has written to me regarding the meetings of the E.M.M.U. at Scheveningen. It was agreed that the M.K.S. system should have units which were consistent with the C.G.S. system, and all the representatives of the different countries agreed that it was very desirable that the present practical system should be extended so as to make it a coherent system of units. When the matter came up for discussion at the Committee of E.M.M.U., the question under discussion was divided into two. The first was concerned solely with the desirability of a coherent M.K.S. system without specifying the fourth unit, and the second with the choice of the fourth fundamental unit. On the first question, all the members declared themselves in favour of the adoption of an M.K.S. system with four fundamental units, except the representative of Norway, who abstained. On the second question, the Committee decided to consult, on one hand the Consultative Committee of the B.I.P.M., and on the other hand, the S.U.N. Dr. Lombardi was asked to prepare the question to submit to the Consultative Committee of the B.I.P.M., and Dr. Kennelly to prepare that to be submitted to the S.U.N. Although there is nothing in the minutes of the proceedings stating that the basis of the decision regarding the fourth unit should be that the permeability of free space should be taken as unity, that point was repeatedly raised in the discussion, and the way in which the matter was left, was that the committees to be consulted should be asked to give a value for the fourth unit which was consistent with the value of the permeability of free space being equal to unity.

It was agreed by everyone that the fourth unit to be adopted (either a unit of quantity of electricity or a unit of resistance) must be consistent with the C.G.S. system of units, and the reason why the question of the fourth unit was referred to the two committees concerned, was that the Commission was anxious that whatever unit was chosen should be consistent with the C.G.S. system of units.

Yours very truly,

E. W. MARCHANT.

Points from Foregoing Letters

DR. J. K. MARSH and Prof. S. Sugden describe and tabulate results obtained by bombarding rare earth elements with neutrons. Radioactivity of varying intensities, with half-life from a few minutes to two days, was produced in nine out of thirteen elements. Europium, dysprosium and holmium were found particularly active; it is suggested that these elements may be useful as neutron detectors. Prof. G. Hevesy and Miss Hilde Levi give a similar table for the radioactivity induced in eleven rare earth elements. The two tables are not in entire agreement, owing, as both groups of investigators point out, to the difficulty of obtaining the rare earths in a pure state. Neodymium and gadolinium, the activity of which is given as zero by Marsh and Sugden, are said, by Hevesy and Levi, to have a slight activity; the values for the intensity and half-life in the case of several other elements also differ in the two tables.

The rate at which molecules of heavy hydrogen gas are exchanged for the hydrogen atoms of water molecules in a suspension containing lactic acid bacteria varies with pressure, the velocity constant being inversely proportional to the square root of the pressure, according to Messrs. G. H. Bottomley, B. Cavanagh and M. Polanyi. The active catalytic agent is an enzyme equally active whether the bacteria are dead or alive.

M. A. Pérard describes the methods employed in determining the length of the national prototypes of the standard metre, and concludes that in spite of the raggedness of one of the fiduciary lines, an accuracy of 0·2 microns is possible. Dr. W. E. Williams emphasises the fact that accuracy would be greater if an optical gauge were used in place of the line standard. He still believes it possible that a discrepancy of 0·56 microns in the length of the British and German standards may exist.

F. Watson, Jr., reviews critically theories dealing with the origin of tektites, which are small glassy particles of lens-like, pear or dumb-bell shape, found at various places on the earth's surface. He concludes that no satisfactory meteoric theory of their origin is as yet available.

Prof. W. C. O. Hill records that a specimen of loris, one of the Indo-Malayan lemurs, was born in captivity in Colombo, and describes the breeding habits and period of gestation of the species.

A histological study of the carotid swelling in the South African bullfrog, *Pyxicephalus adspersus*, by Dr. G. Eloff, has shown that it is a much elaborated artery with a relatively thick media. Before the internal carotid artery leaves the swelling, the common carotid breaks up into a *rete mirabile*, in which melanophores occur abundantly, and probably also nerve-cells. Constriction of the carotid swellings did not affect the heart-rate.

The formation of a loop during the conjugation of heterozygous chromosomes (derived from unlike parents) of the fruit-fly, *Drosophila melanogaster*, during fertilisation is described and illustrated by Messrs. B. N. Sidorov, N. N. Sokolov and I. E. Trofimov. In order that homologous portions of the chromosomes may lie side by side notwithstanding the presence of an inversion in the order of the genes in one of the chromosomes, a 'loop' is formed as a result of a single crossing-over in an inverted region.

Prof. C. Białobrzeski and I. Adamczewski have found that the use of liquid dielectrics is advantageous for the study of the cosmic ray bursts. In an ionisation chamber of 1 litre capacity filled with carefully purified hexane, they observed 37 bursts in 13 hours. Several bursts are double or even of more complicated structure.

Research Items

Origin of the Domesticated Horse

IN a survey of the evidence bearing on the evolution of the modern domesticated horse, Dr. Max Hilzheimer (*Antiquity*, 1935, June) confirms the surprising inference from the bones found in the Royal Tombs at Ur that the early Sumerians had domesticated the Asiatic dziggetai or onager. Bones since found at Tell Asmar include numerous remains of the onager, but none of animals resembling the horse. There are two, possibly three, varieties of the early horse. It is represented in palæolithic art; but it was not domesticated until neolithic, and in places, bronze age times. Its habitat was north of the central Eur-Asiatic mountain chain, except for Spain, and extended from western Europe to Mongolia. Of the two varieties, the Tarpan lies west of long. 40°, Przewalski's horse to the east. An early classification divided the domesticated horse into an oriental and an occidental breed, contrasted as in the Arab and the Clydesdale; but an early breed indigenous to Europe and native to Poland is the Konink. Notwithstanding opinion to the contrary, the original home of the Arab or oriental type is Europe, its distinguishing characters being due to climate and careful breeding. The earliest representations appear on the monuments of Assyria dating to the first half of the first millennium B.C., though it had been introduced there long before by Aryan tribes. In varying form this is the horse of the Egyptians, Hittites, Greeks, Romans and Scythians. The so-called occidental horse has been thought to be descended from the prehistoric horse, of which remains are found in the glacial deposits of Central Europe; but the break in continuity precludes this view. It first appears in dual form as the Noric horse and the horse of Persepolis of the fifth or sixth century B.C. The heavy draught horse is first seen on a tombstone at Chalon-sur-Saône in the second century B.C., and there can be little doubt that, like the Arab type, it was a product of breeding and climate which appeared first in the countries, broadly, bordering on the North Sea.

The Tongue

PROF. DAVID KATZ, formerly of Rostock University, has communicated to the Manchester Literary and Philosophical Society a summary of the results of his research on the tongue as a primitive sense organ (*Mem. Manchester Lit. and Phil. Soc.*, 1933–34). All theories of evolution, however much they may differ, agree that life must have originated and developed in water and later adapted itself to conditions on dry land and in the air. Psychologically, this is manifested in the strength of our need of water. The function of perceiving wetness seems to be restricted to one organ, the tongue. The sense of taste is a specific chemical sense; and it is a near-sense as it has to have contact with the chemical stimulus without the intervention of a medium. It cannot taste solids; they must be dissolved, this being the function of the saliva. The tongue is also remarkably sensitive to an electric current. With regard to the sensations of wetness and dryness, while all the external surface of the body is dry, the internal surfaces are moist. Normally, neither wetness nor dryness is felt in a specific manner. The only part of the body which gives a real subjective impression of wetness is the tongue, while the pharynx gives a nearly permanent impression of dryness. Together they probably form a single sensory unit which as a whole plays an important part in supervising the water economy of the body. The sensation of dryness in the pharynx controls the secretion and swallowing of the saliva. With regard to electric taste, a series of experiments has shown that an opposition of taste is created at anode and cathode of sour-salty and bitter-sweet, which can also be described as relatively bright and dark or heavy and light in analogy with the impressions of other senses, while other, tingling sensations are experienced which probably represent the generation of gas. These impressions do not depend on the metal used, and whatever the combination the threshold appears at the same intensity of current.

Ecological Conditions in Coffee Plantations

UNDER the title of "The Climate and Eco-climates of Coffee Plantations" by Mr. T. W. Kirkpatrick, entomologist, East African Research Station, Amani, Tanganyika, there has recently appeared a memoir interesting to entomologists and botanists alike. The investigations concerned were undertaken in coffee plantations in Kenya Colony. After discussing the standard climate of the district concerned, the author deals with the air temperature at a height of 1·3 metres between the rows of coffee bushes, and compares it with that in the standard screen. Similar temperatures inside a coffee bush are also recorded, together with the temperatures of the leaves of such a bush and the body temperature of an insect (*Antestia*) on the surface of a bush. Soil temperatures, humidity, precipitation, evaporation, light and other factors are dealt with in detail. The author then goes on to discuss the various factors which modify the climate of a coffee plantation. It was found that, in general, the climatic conditions in a plantation differ widely from those which obtain in a standard meteorological screen, and do not always vary in the direction which might be anticipated. It is possible, however, to deduce, with fair accuracy, the extent to which these conditions will vary from a standard. The author describes the technique employed, and the data obtained, in detail. The work is an important original contribution which should be read by all ecologists and may be obtained, price 5*s*., post paid, from the Research Station at Amani, or from the Crown Agents for the Colonies, 4 Millbank, S.W.1.

A Cure for Lime-induced Chlorosis of Fruit Trees

A yellowing of the foliage of apples and pears, induced by lime, causes a considerable amount of damage in some fruit-growing areas. Dr. T. Wallace, of the Long Ashton Research Station, has shown that this state can be remedied by the simple expedient of allowing grass to grow between the trees. This is not always desirable, however, and in a recent paper he gives the results of his experiments with a new method of treatment (*J. Pomol. and Hort. Sci.*, 13,

No. 1, March 1935). The method is very simple. Holes are bored in the trunk with a brace and bit, a small quantity of ferrous or ferric citrate is placed within, and each hole is then closed with a cork. Treatment by this method has been quite successful, and has converted failing trees into healthy specimens. It only remains to investigate the duration of the treatment over a period of years.

Encroachment of the Sahara

IN a paper in the *Geographical Journal* of June, Prof. E. P. Stebbing directs attention to the serious threat to the West African colonies of Great Britain and France by the encroachment of the Sahara. This is due, not to climatic causes, but to the methods of agriculture pursued. Shifting cultivation is still the practice. A piece of forest is felled, the timber burnt and the ground is sown and ultimately harvested. When the weeds become too heavy, or the yield inadequate, the patch is abandoned and a new one occupied. Thus the deciduous forest on the verge of the Sudan becomes degraded, more open and drier. Eventually savannah supervenes, which in West Africa is a term applied to bush or scrub. Herds of the nomadic shepherds then occupy and further destroy it. When its fodder value has almost gone, the herdsman cuts the scrub trees to get fodder for the goat. This is the last stage in the ruination of the land and the advance of the desert. Prof. Stebbing traces the degradation of the forest with the associated ruin of the land in a broad belt in Nigeria and elsewhere, and strongly advocates the need of reserving a belt of degraded forest at least some fifteen miles in width and more than 1,300 miles in length, in which tree growth could be improved and further destruction checked. Thus the advance of the Sahara might be stopped.

Old Maps of Wales

A USEFUL account of the maps of Wales up to A.D. 1600 is published by the National Museum of Wales ("The Map of Wales". By Dr. F. J. North. 1*s*.). Apart from diagrammatic representations on the Peutinger Table, Ptolemy's maps and medieval mappae mundi and portolan charts, there was no map of value until the latter part of the sixteenth century, when there were published the Mercator map, the Lhuyd map and, most notable, the Saxton map. These are fully discussed. But of equal interest is the anonymous fourteenth century map known as the Gough map in the Bodleian library. Its date is uncertain but probably so early as 1340. The volume contains representations of parts of many of the early maps.

Atomic Weight of Terbium

THE isotopic composition and atomic weights of the rare earth elements as determined by F. W. Aston (*Proc. Roy. Soc.*, **146**, 46; 1934) are sometimes in marked discrepancy with the chemical values. In the case of terbium, the values are 158·91 (Aston) and 159·2 (international value). A volumetric determination of the atomic weight of terbium, with very pure material prepared by the fractionation of the dimethylphosphate, has been made by J. K. Marsh (*J. Chem. Soc.*, 772; 1935). The oxalate was prepared and the ratio $Tb_2O_3 : 3C_2O_3$ was determined by ignition and by titration with permanganate. The value derived for the atomic weight was 158·9. This assumes the atomic weight of carbon to be 12·00, but if it were raised to 12·01, the value for terbium would be raised only to 158·92. The new value, for which accuracy in the first place of decimals is claimed, is in very good agreement with that found by Aston, and hence both the chemical and mass-spectrograph methods indicate a value 158·9 for the atomic weight of terbium.

Structure of Cupric Compounds

E. G. Cox and K. C. Webster (*J. Chem. Soc.*, 731; 1935) have examined by means of X-rays the structures of some quadricovalent compounds of bivalent copper containing acetylacetone, benzoylacetone, dipropionylmethane and 3-chloroacetylacetone as addendæ. A complete determination of crystalline structure of such compounds would be very laborious, but a consideration of space-group results, cell dimensions and optical properties shows clearly that the molecules are planar, that is, the four valencies attached to the copper lie in one plane and are not tetrahedral. Since compounds in which a planar distribution has been established appear to be in no way exceptional, it is reasonable to infer that the planar configuration is normal for four-co-ordinated compounds of bivalent copper. This result, which confirms the view expressed by Werner, is not in accord with the conclusions of Mills and Gott in 1926, who obtained a strychnine salt of cupribenzoylpyruvic acid showing a small but definite mutarotation, and inferred that the valency arrangement was tetrahedral. The case for optical activity, however, rested only on analogy with the behaviour of the brucine salt of the corresponding beryllium complex. Since there is no doubt as to the tetrahedral configuration of beryllium, it seems that this analogy is false, and that the observed results of Mills and Gott were due to some cause other than a tetrahedral copper atom. According to Pauling, a planar configuration is to be expected when *s*, *p* and *d* electrons are involved in the valency bonds. It is possible, therefore, that bivalent copper possesses a complete 3_3 sub-group of ten electrons, some being shared, instead of an incomplete group of nine, as is usually supposed. This would involve one unpaired electron in the fourth principal quantum level, giving rise to a paramagnetic moment of the same order as that which has been found.

Nova Herculis

DR. A. BEER has published (*Mon. Not. R.A.S.*, **95**, 538) a light curve of Nova Herculis from the time of its discovery (December 12, 1934) up to April 3, 1935. This is based on visual or photometric measures by numerous observers and shows well the main features of the changes observed, including the steep rise just after discovery, the rapid fluctuations with a very slow average decrease, until the final spectacular drop of more than five magnitudes within a few days. The more recent recovery from the thirteenth to the eighth magnitude is not covered by the range of dates discussed. Measures of the spectra taken at Cambridge on these dates with the 15-in. Huggins refractor over the visual region from $H\beta$ to a little beyond $H\alpha$ (7331 A.) are included. About 150 emission lines or bands have been measured in this region, for the majority of which probable identifications are given, with the origins of other possible blending lines. Laboratory intensities and multiplet classifications are given for all the origins suggested.

Excavations at Tell Duweir, 1934-35

EXCAVATIONS at Tell Duweir, the Biblical Lachish, in the third season of the Wellcome Archæological Research Expedition to the Near East, of which Mr. J. L. Starkey is director, carried on the further exploration and clearance of the cave-dwelling settlement of the Early Copper Age which lies to the north-west from the Tell, the clearing of the temple and shrine outside the city walls at the north-west corner of the Tell, which was discovered last year and then shown to be contemporary with the xviii and xixth Dynasties of Egypt, the completion of the examination of the Iron Age cemetery to the south-west, the further clearance of the gate at the south-west corner of the Tell, with its subsidiary works, and further work on the summit of the mound, which included the clearing of the Persian shrine of the Sun. A considerable amount of labour was also expended on retaining walls for terracing the west side of the Tell and other necessary work for the disposal of the material to be removed in the course of excavation.

The season's finds have more than justified expectations based upon estimates of the importance of the site, apart from its size; and interesting as were the finds of last year, especially the discovery of the shrine with its associated examples of a localised art, reminiscent of Tell el-Amarna, and the fragments of the ewer inscribed with a primitive script showing affinities with the famous Sinai script, the results of the season recently closed show no falling off in interest. Indeed in certain respects, more particularly in the importance and the immediate applicability of the epigraphic material to Biblical studies, they may even be said to transcend previous discoveries. In addition, the epigraphic material has provided direct documentary evidence confirming the identification of Tell Duweir with Lachish.

The evidence which comes from the area to the north-west of the Tell, including what has been termed the prehistoric suburb, continues to point to a surprisingly extensive settlement and relative density of early prehistoric population. Further excavation in the cave-dwelling area of the æneolithic period has produced additional examples of the characteristic red ware in a variety of forms. One remarkable example is a very large jar, approaching a metre in height, which now has been reconstructed. It shows the peculiar feature of a vertical fissure or gap, of which the worn edges point to the use of the jar in two separate halves for some considerable time. With a number of carefully and beautifully formed flint knives, hoes and sickle blades with serrated edge were implements of pure copper. Of these last one was a remarkably well-preserved copper dagger, which had been beaten to a high degree of hardness and is among the earliest known from Palestine.

On the whole, the pottery of the Copper Age is at its best in the earliest period. In common with other elements in the culture, it shows a progressive deterioration as time goes on. One example of such degeneration, to which attention was especially directed in the collection of pottery dating from 3000–2000 B.C. shown at the Wellcome Research Institution, was to be seen in the form of the characteristic ledge-handles on either side of certain types of vessel. Throughout the period, from about 2800 B.C. onward, these dwindle away until they become the merest vestigial trace without apparent meaning. An interesting suggestion as to the purpose of these remarkable, if characteristic, ledge-handles has been put forward by Mr. Starkey, who thinks that they may have served as a grip to enable solid sediment, such as that which would be left by beer, to be shaken from the vessel.

In clearing the temple and shrine lying outside the walls at the north-west, evidence was found, strange to say, of a degradation somewhat similar in character to that deduced from the finds of the Copper Age. Three temples had been erected on the site. Between the erection of the earliest before 1400 B.C. and the destruction of the third in 1260 B.C., there is a progressive decline in the character of the temple and in material employed in the shrine and its appointments. It will be remembered that one of the most remarkable features of this discovery, apart from the character of the shrine as a whole, were the ivory carvings and carved inlays, which in style recalled the art of Tell el-Amarna, but were attributed to a local school of art. While the main characteristics of the cult appear to be constant, the inlays first change to bone, copying, but in a debased form, their ivory originals, and then, in the period of the third temple, clay figures appear. In like manner, in the last phase, the probable portable altar of the second shrine becomes a solid structure of brick, and the shrine itself is but mud lime-plastered.

Ivory rods of unknown use also appear in shortened form in clay. It has been suggested, however, that clay, which could be heated, would be a more suitable material, if these rods were, as conjectured, used for making the closely curled ringlets in hair and beard which adorn the inhabitants of Palestine in the Assyrian bas-reliefs.

Among the tombs of the Early Iron Age, or Solomonic period, an outstanding find was one which, there is reasonable ground for concluding, contained the mortal remains of a priest or minor official of the temple. This conclusion rests on the evidence of a remarkable three-pronged fork or trident of iron which lay at the entrance. It is some two feet in length and has a short handle. Its form immediately suggests a "flesh hook" for lifting meat from an offerings bin, such as that to which reference is made in *Samuel* I, ii, 13–14. Associated with this burial was an interesting collection of beads and a small ivory tablet, in which thirty holes in three vertical columns may have served as a memorandum or calendar to mark the feast days of a thirty-day month.

Before dealing with the finds which follow here in strict chronological order, a brief reference must suffice for the finds of the Persian period from the shrine of the Sun God. Among these were some striking zoomorphic figures in clay and some equally remarkable miniature altars of stone, on which were crude engraved designs of men, trees and animals.

What is beyond question the most important discovery of the season is epigraphic and historical, rather than purely archæological in interest. A fragment of pottery inscribed in the same primitive script as that of the inscription on the fragmentary

ewer found last year has added three characters to those previously known. Even more important, however, to the historian and Biblical student, is a series of letters which belongs to the period immediately before the destruction of the city by Nebuchadnezzar in 598 B.C. The letters, mostly complete, and in some instances running to some length, are on seventeen ostraka which were found among the debris of the guard-room of the gate giving access to the fortress at the south-western corner of the Tell. They are written in ink in an early form of Hebrew, and according to a decipherment and translation made by Prof. Harry Torczyner, of the University of Jerusalem, were addressed to the commander of the garrison of Lachish from a subordinate command. One letter is much concerned with the observation of signals and suggests that it refers to a system of smoke signals by which communications were maintained between Lachish and the supreme command. This letter also refers to Lachish by name.

In a list of names of individuals in the correspondence a form compounded with *yahu*—a form of invocation of Yahweh (Jehovah)—predominates; but one among the names of the fathers of the individuals cited is given, not as a yahu compound, but as an El-compound (El-Natan). This points to a change from El to Yahweh worship within the lives of father and son, probably a result, it is suggested, of the reforms of Josiah. Of even greater interest to Biblical scholars is a reference to a prophet who had been the cause of disturbance, and the passing of a commander-in-chief, Akhboryahu, son of El-Natan, on his way to Egypt, which is clearly a reference to persons and incidents mentioned in *Jeremiah* xxvi, 20–22.

Scientific Management

THE papers given at the Sixth International Congress for Scientific Management held in London during the past week have been available in print for members since early in May (Secretary of the Congress, 21 Tothill Street, London, S.W.1). They are published in six volumes corresponding with the six sections of the Congress and are grouped under subject headings relating to the particular themes to be considered at the four sessions held by each section. Nearly all the 200 papers have a certain scientific interest, so that any selection from them is difficult.

Dealing with the subject of preliminary education for management, Mr. A. P. M. Fleming points out that at present provision is seldom made in industrial concerns to ensure continuity of good management beyond a single generation. The methods of selection of staff are discussed by competent authorities from the German, French, British, Dutch, Italian and Swiss points of view, so that a comprehensive picture of modern thought on this subject is available. When summarised, the information should be of great importance to educational advisers who have to help to place young men in life.

Opinion is hardening in business circles that the entrants from school should receive a good deal more vocational training than at present. The recruitment of personnel suitable for high administrative positions is likewise discussed in several papers. The National Institute of Industrial Psychology is responsible for a communication which deals with the vexed question of promotion versus engagement from outside on the basis of the experience gained by the Institute, and schemes are put forward showing how to discover men within a company for training and how to select from outside. The Dutch authors regard personnel selection as a profession in itself: the Italians would invoke a psychotechnical criterion.

It is widely said that there is a shortage of men to-day for the senior posts, probably because of the toll taken by the War of the more enterprising. It is clear that there is world-wide concern with regard to leadership: hence the numerous suggestions as to the form of training. The volume containing the educational and training section papers deserves to be read as a whole both by executives who have the choice of their successors and by the educationists.

In the development section the bulk of the papers discuss the correct methods of inculcating modern management principles and practices. They come from many lands and cover a variety of problems. Thus C. G. Renold describes the steps taken in the merging and subsequent rationalisation of a group of companies employing 5,000 people; he attempts to assess the costs involved and the benefits resulting: this is a most valuable contribution. H. J. Mitchell discusses the methods adopted by Imperial Chemical Industries, Ltd., of which he is a leading director, in the management of its many activities, the general desire being to have a stable organisation where stability is essential but a high degree of flexibility in other directions where research and development require it. Whereas management of the groups is decentralised, finance is fully centralised. The Company's whole-time directors are relieved of direct executive duties, and a considerable amount of authority and responsibility is delegated. This account of the management of our largest undertaking contrasts with one, describing the methods used in a small tapestry factory, which follows it.

The account of the I.C.I. scheme of management will be widely studied, the more so as it is realised both that the problem of the successful management of so large an organisation is one of very great difficulty and that the difficulties have been largely overcome by I.C.I. along the lines outlined.

A second series of papers in this volume deals with the rôle of institutions, trade and other associations in relation to management problems. A thoughtful summary contributed by a committee representing the Federation of British Industries analyses the association movement as affecting efficiency, and makes some constructive suggestions as to the manner in which trade associations can be of assistance.

In the manufacturing section the subject of budgetary control attracts first notice. An important review representing the accumulated experience of some of the leading firms in Great Britain is contributed by Roland Dunkerley. The idea indicated by the term is to substitute considered intention for opportunism in business; it has been much discussed and studied during recent years, and the theories of

such control are firmly established and widely known. Its application is proving increasingly successful though it is necessary to adjust the principles to meet the varying demands of the various industries.

A second group of papers deals with scientific methods applied to works management in a number of specific examples.

Distribution is becoming very definitely a science. It is axiomatic that the manufacturer of a new product must sell it and that the true market is always the ultimate user. A paper contributed by the Advertising Association of Great Britain gives a particularly good summary of the routes through which a new product can be distributed to the public, with concrete examples of recent introductions. Any reader of this volume who has the task of introducing a new product can easily ascertain the international views as to how he should begin his task. Large organisations are finding it worth while to establish special departments for marketing research: some of the methods employed and results obtained in the United States are described by Mr. O. F. Roost. As one industry after another reaches a point where it is able to produce more than the market can apparently consume, competition becomes keener and the need for more intimate and accurate knowledge of existing markets and possible new ones becomes apparent. E. F. A.

The Metallic State

A CONFERENCE on "The Metallic State" was held in the University of Bristol at the H. H. Wills Physics Laboratory on July 2–5, about forty visitors being present from other parts of England and from the Continent. Most of the visitors were housed in Wills Hall, one of the University halls of residence.

At the opening session of the Conference, Dr. J. A. Prins (Groningen) gave an account of the results obtained at the University of Groningen on the absorption and emission of X-rays by metals. The absorption spectrum in crystalline solids has a fine structure extending several hundred electron volts on the short wave-length side of the edge, and depending in its general features only on the structure, and not on the atomic constitution of the crystal. A theoretical explanation due to Kronig was discussed, which relates the phenomenon to the Bragg reflection of the ejected electrons. Dr. H. W. B. Skinner (Bristol) showed how the study of emission bands in the ultra-soft region can give information about the occupied electronic states in metals. Prof. W. L. Bragg (Manchester) gave a report of some recent results obtained by Sykes on the formation of a superstructure in copper-gold alloys, and Mr. J. D. Bernal (Cambridge) discussed the factors which determine the crystal structure of alloys, pointing out especially that the atomic radii of the constituents have often a decisive influence.

The morning of July 3 was devoted to a discussion of the liquid and amorphous states. Prof. H. Mark (Vienna) gave an account of recent theories of electrical conductivity, and Dr. J. A. Prins gave a report on his own work on amorphous antimony. Dr. G. W. Brindley (Leeds) showed the effect of filing on the intensity of X-ray reflection from metals. In the afternoon there was a discussion on the properties of metallic bismuth, in which Prof. A. Goetz (Pasadena), Dr. N. Thompson (Bristol), Dr. D. Shoenberg (Cambridge) and Dr. H. Jones (Bristol) took part. Bismuth is peculiar in that very small quantities (less than 0·1 per cent) of lead, tin or other metals in solid solution have a very marked effect on its electrical conductivity and diamagnetic susceptibility. Prof. Goetz expressed the opinion that these facts suggest the existence in bismuth of a microcrystalline superstructure of the kind postulated by Zwicky, but an alternative explanation was suggested in terms of the wave mechanical theories due to Peierls and Jones. These theories, however, will require further development before any quantitative account of the facts can be given.

On July 4, Prof. W. Gerlach (Munich) gave an account of the work carried out in his laboratory on the electrical resistance of nickel and of some of its alloys. The resistance of nickel decreases in a magnetic field, the decrease being proportional to the change in σ^2, where σ is the magnetisation. Further, the resistance plotted against temperature shows a kink at the Curie point. A possible explanation of the effect was suggested by Prof. N. F. Mott (Bristol). Dr. E. C. Stoner (Leeds) pointed out that various methods of determining the Weiss intramolecular field constant in nickel give very discordant results, and suggested an explanation.

On July 5, a discussion on supra-conductivity was opened by Dr. J. M. Casimir (Leyden), who gave an account of the fundamental experiments of Meissner, and of de Haas and Mrs. Casimir, and of the important theoretical advances of Gorter, Casimir and London. Mr. K. Mendelssohn (Oxford) gave an account of the behaviour of certain alloys. It appears that though great progress has been made towards the understanding of the thermodynamics and electrodynamics of a supra-conductor, we are still as far as ever from knowing the cause of the phenomenon. Dr. H. Niewodniczański and Mr. C. J. Milner (Mond Laboratory, Cambridge) discussed the electrical conductivity of non-supra-conductors, and here also the results of theory are by no means in accord with experiment, and the opinion was expressed on several sides that all theories are wrong below 4° K. Prof. F. Simon (Oxford) and Dr. E. Teller (London) also discussed the possibility of using nuclear spins to obtain yet lower temperatures than can be obtained with ordinary paramagnetics by the magnetic cooling method.

An interesting feature of the Conference was the frequent mention of experimental facts for which no quantitative theoretical explanation could be given. Considerable advances have recently been made in the quantum theory of the metallic state, and it is now possible for the theorist to give an indication of why certain metals have their particular crystal structures, magnetic properties and electrical conductivities. Nevertheless, the theory is as yet far from being able to give such a complete account of the experimental data as is possible, for example, in the field of atomic spectra.

Biology at the Imperial Social Hygiene Congress

AT the recent Congress held under the auspices of the British Social Hygiene Council at the London School of Hygiene and Tropical Medicine, the teaching of biology formed the main topic of the papers read during the educational sessions. It is satisfactory to hear from Dr. E. W. Shann that it is now realised that there are two categories of pupils to be considered in the drafting of syllabuses, namely, those for whom biology is a necessary part of their general education, and those who require it for vocational reasons. Up to an early stage, the needs of these two may be regarded as identical; and they will probably be met by a well-balanced course of general elementary science in which hygiene and the functions of the chief organs of the human body should certainly be included. The scheme advocated by Mrs. E. J. Hatfield, which is already in use in many girls' schools, and deserves the attention of others where the ages of pupils permit is: Age 11–12 years, general elementary science; age 12–14 years, chemistry, or chemistry and physics; age 14–16 years, general biology, and in addition, chemistry or physics for future science specialists.

For purposes of general education, biology is unquestionably preferable to either zoology or botany; and that this is becoming more widely recognised by teachers is shown by the steady increase in the number of candidates offering biology at certificate examinations, and the corresponding diminution in that of those offering either of the other subjects. A knowledge of the structure and life-histories of a few typical animals and plants does not bestow on its possessor a biological outlook on the world around him and on the problems of mankind: the type system is dead so far as general education is concerned. It is biological topics rather than types that will eventually produce a biologically minded public, and, it is to be hoped, lead to social legislative measures based on the conviction that man is subject to the same laws of Nature as are all other animals.

The topics that are essential in such a course are (1) food elaboration by green plants, the source of all vital energy and conversions of energy; here is abundant opportunity for personal experimental work, even on the large scale, in rural schools possessing gardens; (2) the structure of a mammal, and the functions of the chief organs; (3) reproduction, asexual and sexual, in plants and animals; parental care, and its importance in evolution; (4) the web of life, and mutual interdependence; heredity; evolution; biology in the service of man; (5) bacteria and fungi, and their rôle in the nitrogen- and carbon-cycles.

It is obvious that mammalian physiology will be human; nor is any apology for this necessary. A child is naturally and properly curious about the workings of its own body, and most children are keenly interested in living animals, and perhaps also in growing plants. Thus it becomes easy and not inappropriate to digress from the processes going on in the body of the living child to the methods by which the same processes are effected in other animals and in plants. For example, human respiration may well be followed by the methods of respiration found in, say, fish, snails and insects, and by demonstration of the fact that in plants respiration is essentially the same as in animals. Similar digressions can be made in connexion with all the other metabolic processes, which need not here be specified. In such a course, instruction on the details of structure would be reduced to the barest minimum; morphology is for the specialist, not for the general public; and the topics would be purely biological, and freed from the type incubus.

It is generally conceded that biological teaching is the best method of instructing in the laws of health and in the meaning of sex. Indeed, in some quarters sex-instruction has been the chief reason for advocating the inclusion of biology in all school curricula. Certainly knowledge of the sexual processes in plants and in the lower animals affords an avenue by which approach may be made to the relation of male and female in the human species; but to stress this aspect in a course of general biology is a mistake; the functions of the reproductive system should have neither more nor less attention devoted to them than is given to those of the digestive, respiratory, excretory and the rest.

What matters most is that for all the processes of life there should be instilled a respect, a reverence for the mystery of life, an appreciation of the beauty of the form of living things and of their marvellous adaptations to their environment. Knowledge without the spirit of reverence will not have much influence on the moral conduct of man or of woman.

It is, then, very desirable that training colleges should emphasise this aspect of biology, and should insist on this subject being included in the science course; for the lack of qualified teachers has not yet been made good.

The Museums Association

ANNUAL CONFERENCE AT BRUSSELS

THE Museums Association, which has its headquarters in London, and holds its annual conference at different provincial centres in turn, this year departed from its usual custom, and, at the invitation of the Belgian Government, held its Conference in Brussels, where more than two hundred members assembled.

After the Sunday had been spent in visiting the city and its museums, formal proceedings began on Monday, July 1, when members were officially

welcomed by the Belgian Minister of Education. Sir Eric Maclagan, director of the Victoria and Albert Museum, then gave his presidential address on "The Future of Museums". The increasing tendency in Great Britain for private collections to become absorbed into the public museums of the country, and the continued growth of the latter, has created, he said, a very serious problem, since ultimately the limit is reached beyond which expansion is practically impossible. Those in charge of museums must therefore become more and more selective in the choice of material. The principle whereby the contents of a museum are divided into public collections, exhibited with great care, and study collections available to students, is an ideal one, but it is practically impossible to adapt existing buildings to such a purpose. Another method of limitation, which could be applied to smaller museums, is that of specialisation, whereby individual museums would carry some groups of exhibits as near completion as possible. Museum federations offer opportunities to promote this by means of exchanges.

Above all, Sir Eric said, those in charge of museums should look forward and regulate their own activities with a view to those of their successors. If anything is to emerge unscathed from our troubled times, museums have a higher 'survival value' than almost any other contemporary institution.

The address was followed by a paper from Prof. Jean Capart, *conservateur en chef* of the Musées Royaux d'Art et d'Histoire, on "The Museum Spirit", which is, he said, to restore the voice to the dead. The scientific aspect of museum work is only a beginning; truth must not remain the personal benefit of the scholar, but must be widely distributed.

In the afternoon there were organised tours of the various departments of the Royal Museums of Art and History in Brussels, where in the evening a reception was held.

On the following day, Prof. F. Demanet, of the Musée Royal d'Histoire Naturelle, opened a discussion on "What is the best way of forming a palæontological collection?" The answer is, he believes, by means of regional investigations carried out by specialists, who would note every fact throwing light on the stratigraphy, palæobiology and ecology of the specimens collected. The collection of specimens should, in fact, become a science of observation. After this subject had been discussed by Drs. D. A. Allan and J. W. Jackson, of the Liverpool and Manchester Museums respectively, Dr. W. T. Calman, of the British Museum (Natural History), gave an illuminating account of the planning of the new Whale Room at that Museum, and Mr. K. de B. Codrington rounded off the morning by a scholarly and witty paper on "The Making of Museums".

The afternoon was kept free for visits to the Museums of Fine Arts and of Natural History (the latter remarkable for its fossil vertebrates), and in the evening members were the guests of Burgomaster Max at the Hôtel de Ville.

On Wednesday, July 3, the Museums Association was privileged to attend the centenary celebrations of the Musées Royaux d'Art et d'Histoire, at which Their Majesties the King and Queen of the Belgians were present. After lunch, a visit to the Congo Museum at Tervueren showed how admirably a single Museum could cover all aspects of the Belgian Congo—its history, natural history, economic resources, ethnography and art—and also provided an enjoyable excursion through the Forêt des Soignes. The annual dinner was held in the evening.

The meetings on Thursday, July 4, took place at the International Exhibition at Brussels. After Mr. P. Dikaios had given an account of the reorganisation of the archæological museum at Nicosia, Cyprus, and Dr. H. J. Plenderleith, of the British Museum, had discussed the application of scientific research to the study of works of art—in which he pointed out that the scientific specialist needs a knowledge of painting if he would avoid errors when working in this field—visits were paid to the magnificent collection of "Art Ancien" and to the other attractions, scientific, artistic and popular, of the Brussels Exhibition.

Friday and Saturday mornings were devoted to excursions to Antwerp, with its unique Museum of Printing, the Musée Plantin-Moretus, and to Bruges, where the effective design of the new municipal museum was greatly admired.

During the Conference, meetings were very well attended, in spite of the many counter-attractions of Brussels, of its museums, and of the Exhibition, and at the end of the week those who took part returned to England agreed that the decision to meet abroad had been fully justified by the success of the meeting.

The next annual conference of the Association will be held at the Leeds City Museum and Art Gallery, in July, 1936.

Educational Topics and Events

BELFAST.—At the graduation ceremony on July 10, honorary degrees were conferred upon, among others, Prof. T. G. Moorhead, regius professor of physic, Trinity College, Dublin; Dr. T. Carnwath, senior medical officer, Ministry of Health; Major-General W. P. Macarthur, Deputy Director-General, Army Medical Services; and the degree of D.Sc. was conferred on J. B. Parke for work on the viscosity of emulsions.

DUBLIN.—On July 5 the University of Dublin conferred the following honorary degrees: D.Sc.—Prof. G. T. Morgan, director of the Chemical Research Laboratory at Teddington. Litt.D.—Sir Frederic Kenyon, formerly director of the British Museum. M.D.—Prof. T. H. Milroy, professor of physiology in Queen's University, Belfast, and Sir Norman Walker, direct representative for Scotland on the General Medical Council.

LIVERPOOL.—At a meeting of the Council on July 9, Mr. Thomas Bertrand Abell, professor of naval architecture and dean of the Faculty of Engineering, was appointed pro-vice-chancellor of the University for the session 1935–36. Prof. Abell, who has occupied the chair of naval architecture since 1914, had a distinguished career at the Royal Naval College, Devonport, and has held various appointments under the Admiralty, at the Royal Naval College, Greenwich, and the Royal Naval War College, Portsmouth. During the War he was assistant director of designs to the Admiralty and Ministry of Shipping and was awarded the O.B.E. for his War services.

The Council has also appointed Mr. J. F. Craig to the William Prescott chair of the care of animals as from October next. Mr. Craig has been on the staff of the Veterinary College of Ireland since 1903, having succeeded to the position of principal in 1918.

He has been president of the Royal College of Veterinary Surgeons and is now president of the National Veterinary Medical Association of Great Britain and Ireland. Mr. Craig has been responsible for important researches into diseases of animals in the Irish Free State and has contributed extensively to scientific literature.

SHEFFIELD.—The following appointments have been made: Mr. J. MacD. Croll, to be lecturer in bacteriology; Mr. Mansergh Shaw, to be assistant lecturer in mechanical engineering; Dr. Edward S. Duthie, to be a demonstrator in pathology.

To universities, and the causes they stand for, the series of special university supplements now in course of publication by *Time and Tide* are doing a really valuable service. The third of the series, published with the issue of April 27 under the heading "More and More of Less and Less", elucidates a number of problems, all of first-rate importance, associated with the growth of specialisation in universities. Mr. R. H. S. Crossman's article on "The Problem in Philosophy" sketches with firm lines the situation confronting the modern student of philosophy. Lacking a comprehensive grasp, such as he cannot hope to compass, of the structure of modern scientific thinking, he tends to subside into the rut of history of philosophy on traditional lines or to give himself up to the exploration of the mazes of logistics. A better way is, however, open to him, pending the discovery of means whereby he may be equipped for holding converse with mathematical and physical scientific workers on their own ground: the study of politics and ethics, not *in vacuo* but in relation to contemporary issues. Mr. C. M. Bowra, discussing science and the humanities as studied in the older universities, suggests, *inter alia*, the institution of a course analogous to Oxford's "Modern Greats" combining with philosophy, physics or biology or chemistry. Three other articles deal mainly with conditions of study, in some respects deplorable, in the modern English universities: by Prof. E. R. Dodds on "Departmentalism and Humane Culture", Mr. Pilley on "The Universities and Science" and Mr. Mansell Jones on "'Facts and Skills' or Education". Lastly comes a study of the situation at Durham. A brief retrospect of the salient features of the history of this university is made to illustrate causes and effects of specialisation, and the recent Royal Commission's recommendations are used to point a moral and adorn a tale.

Science News a Century Ago

Progress of Colonel Chesney's Expedition

IN his expedition to the Euphrates in connexion with the project of shortening the passage to India by means of steam navigation, Colonel Chesney had met with some opposition from the Pasha of Egypt, who, however, had given way, and in a letter from "Port William" on the upper Euphrates, dated July 21, 1835, Chesney remarked, "We arrived here four days ago, and the spot where we are at work, has been named as above, in honour of our earliest patron, the King. We are making efforts of no common kind to get afloat, so as to reach Bussora in time to sail from thence upwards, about the 30th of September".

"I put up the little steamer at the Orontes as a sort of hint, that we did not mean to be stopped, but his Highness gave way, and instead of making our steamer take the gear up to Antioch, we broke her into eight sections, and placed them on keelsons and other pieces of timber, with wheels underneath to make their way by land. . . ."

"I do not expect to finish the steamer before we sail downwards, but she will probably be decked and in working trim, as a shell, in which we must rough it as is done here where there are a couple of habitable rooms, some sheds covered with branches, and tents . . . and the whole enclosed by a parapet and ditch, which were thrown up and just completed by one of the officers. . . ."

The Horticultural Society

ON July 21, 1835, a paper was read to the Horticultural Society, by J. Disney, "On the Preservation of the Golden Harvey Apple," a variety so well known for its excellence and general utility that a really good plan for prolonging the period of its maturity was a desideratum.

It was announced that the annual gold medal about to be given by Lord Grey of Groby, for the finest orchideous plants exhibited, had been adjudged to Mr. James Bruce, gardener to Boyd Miller, Esq., of Mitcham, for an extremely fine plant of *Oncidium ciliatum* with forty-four flowers in its panicle which was shown at the meeting on November 4, 1834 (*Athenæum*).

Lyell and the Continental Geologists

WRITING from Paris to Sedgwick on July 23, 1835, Lyell said: "I found here Von Buch, E. de Beaumont, Dufresnoy, Constant Prévost, Virlet, Boué, Alex Brogniart, and have had much talk with all of them, and some warm discussions with Von Buch and de Beaumont. Of the first, I must say that I found much to like in him. As I had handled some of his opinions very roughly, and as he is too much accustomed perhaps to have unbounded deference paid to him by most of his own countrymen, and by no one more so than E. de Beaumont, I had no right to expect a very cordial reception, but he met me with great frankness, and at once set me at ease by vehemently protesting against my numerous and crying heresies, none of which, not even the elevation crater theory, seems to have exacted so much honest indignation as my recent attempt to convey some of the huge Scandinavian blocks to their present destination by means of ice. . . ."

James Bowman Lindsay's Electric Light Experiments

THE *Dundee Advertiser* on July 31, 1835, said: "Mr. Lindsay, a teacher in town, formerly lecturer to the Watt Institute, succeeded on the evening of Saturday, July 25, in obtaining a constant electric light. It is upwards of two years since he turned his attention to this subject, but much of that time has been devoted to other avocations. The light in beauty, surpasses all others, has no smell, emits no smoke, is incapable of explosion, and not requiring air for combustion can be kept in sealed glass jars. It ignites without the aid of a taper, and seems peculiarly calculated for flax houses, spinning mills, and other places containing combustible materials. It can be sent to any convenient distance, and the apparatus for producing it can be contained in a common chest".

Societies and Academies

PARIS

Academy of Sciences, June 3 (*C.R.*, 200, 1893–1996). LUCIEN CAYEUX : The constitution of the Senonian phosphates of Palestine and Transjordan. LOUIS JOUBIN : The plankton cephalopods of the Atlantic Ocean (cruises of the *Dana* in 1921–22). ANTONIN GOSSET and IVAN BERTRAND : The utilisation of a segment of marrow as a heteroplastic graft of the peripheral nerves. SERGE BERNSTEIN : Some extremal properties of successive integrals. EMILE MATHIAS : The curvature of the diameter of the densities. JEAN CABANNES : The red lines of oxygen in the nocturnal sky. RENÉ MAIRE and ERNEST WILCZEK : The vegetation of the western Sahara. HUSNI HAMID : Regular varieties of higher order. SIMON DE BACKER : A new form of the equations of the dynamics of gases. GEORGES DURAND : The exactness of Eddington's mass-luminosity relation. CHARLES BORY : The natural convection of wires : the existence of a new state of convection. With a very fine wire (25 microns), measurements of the convection coefficient indicated the existence of two regimes. PIERRE VERNOTTE : The laws of convection. Theoretical discussion of the experimental results in the preceding communication. JEAN VILLEY : The calculation of the energy loss on combustion. LÉON DUBAR : The influence of vapours and occluded gases on the electrical conductivity of cuprous oxide. The electrical conductivity of compact cuprous oxide is reduced by water vapour. JEAN GENARD : The action of the magnetic field on the absorption bands of the molecules of sulphur. FRED VLÈS and ERWIN HEINTZ : The infra-red spectrum of protein substances. HENRI MURAOUR and GABRIEL AUNIS : The agreement between the calculated and experimental pressures for explosive mixtures giving rise to gases rich in steam. MARCEL LECOIN : The β-radiation of actinium *C″*, of mesathorium 2 and of uranium X_1 and its derivatives. MME. LUCILE S. MATHIEU-LÉVY : The spectrophotometric study of the adsorption of copper in ammoniacal solutions by precipitated ferric hydroxide. WILFRIED HELLER : The determination of atmospheric ozone by fluorescein. This has advantages over the iodometric method ; but may give high values owing to the presence of oxides of nitrogen in the atmosphere. EMILE ELCHARDUS and PAUL LAFFITTE : The constitution of the magnesium-zinc-silicon alloys rich in magnesium. MME. LÉONE WALTER LÉVY : The basic magnesium carbonates. MME. ZINA SOUBAREW-CHATELAIN : Mannitodimolybdic acid. The complex acid, the existence of which had been deduced from physical measurements by Honnelaître, has been isolated and has the constitution $H_2Mo_2O_7,C_6H_{14}O_6,H_2O$. GEORGES RICHARD : Contribution to the study of the α-halogen ketones. HENRI LONGCHAMBON and GEORGES MIGEON : The definition of the sepiolites. STOYAN PAVLOVITCH : Study of the Zlatibor gabbros (western Serbia). RENÉ PERRIN : Metamorphism generator of folds. JEAN LOMBARD : The geological structure of central Oubangui-Chari. GABRIEL LUCAS : The age of the Djebel Tenouchfi (Department of Oran) layers. JEAN DRESCH : The recent formations of Haouz de Marrakech. PAUL DELEAU : The facies of the lower Cretaceous of the region of Hammam Meskoutine (Constantine). GEORGES DENIZOT : The tectonic of the Nerthe and the Etoile, near Marseilles. GEORGES CORROY : The bases of the Hercynian massifs of the neighbourhood of Toulon. WILLIAM HENRI SCHOPFER: Generalisation of the auxogen action of the vitamin B_1 on a micro-organism. ROBERT BONNET and RAYMOND JACQUOT : Evolution of the culture media in the growth of *Sterigmatocystis nigra* as a function of the age of the mycelium. RAOUL COMBES : Nitrogen nutrition of the flower. RENÉ SOUÈGES : Embryogeny of the Rosaceæ. Development of the embryo in *Potentilla reptans*. CHARLES CHABROLIN : Germination of the seeds and plant hosts of *Orobanche speciosa*. EMILE MIÈGE : Influence of cold on the conservation and productivity of the potato. Maintenance of the tubers at 4°–5° C. for several months had a favourable effect on all the varieties examined : the state of preservation was perfect and the productivity high. RAOUL LECOQ : In a balanced ration, can the corresponding fatty acids be used instead of glycerides ? They cannot. DAVID NACHMANSOHN, JACOB WAJZER and MLLE. RUTH LIPPMANN : The effect of adrenaline on the metabolism of isolated muscle. MME. VERA DANTCHAKOFF : Experimental sexual inversion of the testicular element in the embryo of the fowl. CAULLERY : Remarks on the preceding communication. VICTOR PLOUVIER : Researches on the isomerisation of cyanogenetic heterosides. MICHAEL A. MACHEBŒUF and HENRY CASSAGNE : Chemical studies on the diphtheria bacillus. Fractional extraction of the lipids of the bacillus ; separation of the haptene fraction ; the presence of soap in the bacillary bodies. ALBERT GORIS and HENRI CANAL : The presence of 2.oxy.5.methoxyacetophenone in the essence of the rhizomes of *Primula acaulis*. FRANCIS RATHERY, LOUIS ROY and MICHEL CONTE : The spontaneous variations of the glycæmic curve of diabetics. JEAN CUILLÉ CHELLE and BERLUREAU : The existence in France of a bovine anaplasmosis of indigenous origin.

LENINGRAD

Academy of Sciences (*C.R.*, 2, No. 2, 1935). M. KRAVTCHUK : An algebraic point in the problem of moments. A. POPOV : (1) On some series. (2) Series containing cylindrical functions. V. KUPRADZE : The problem of unity in the stationary marginal problems of the theory of elasticity. V. ANTONOV-ROMANOVSKIJ : The influence of an unequal distribution of phosphorescence centres and of related factors on the dimming of the Lenard phosphorus. M. KORSUNSKIJ : (1) The curve of mass defect in the heavy elements. (2) Deviations from the Sommerfeld formula for the *k*-levels. A. ZAICEV and G. SPIVAK : On the exchange of energy between atoms of neon, argon and mercury, and a solid wall. N. SELJAKOV and E. SOVZ : The nature of 'recovery' in metals and of the re-crystallisation in monocrystals of aluminium. I. KNUNJANC and M. GERCHUK : The condensation of the α-formyl-succinic ester with esters of α-haloid-substituted acids. I. KITAJGORODSKIJ : Theory of glass manufacture. D. BELJANKIN : Influence of mineralisers on the formation of sinter-corundums. M. CHAJLAKHJAN : The permeability of the plasma in the leaves of spring and winter wheats. M. CHAJLAKHJAN and V. ALEXANDROVSKJA : The nature of photoperiodic after-effect (induction) and on the effect of the length of day on the activity of the oxidising enzymes. M. SHKOLNIK : The need of plants for boron. E. MININA : The influence of the technique of distributing fertilisers on the quality and yield of wheat.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 181–234, April 15). CARLETON R. BALL: New varieties of Western [American] willows. LINUS PAULING: The oxygen equilibrium of hæmoglobin and its structural interpretation. Assuming that the hæmoglobin molecule contains four equivalent 'hæmes', one equation involving two constants is derived which represents the oxygen equilibrium at constant hydrogen ion concentration, and another similar equation which represents the change of oxygen equilibrium with change of hydrogen ion concentration. These equations give curves agreeing well with experimental curves; they support the view that the four 'hæmes' lie at the corners of a square. B. S. HENRY and A. M. PARTANSKY: The rate and extent of anaerobic decomposition of sulphite waste liquor by bacteria of sea bottom mud. (2) Bacteriological. A number of anaerobic and facultative bacteria were isolated; they seem to be new species. Sulphite waste liquor slows down the growth and fermentation of nine common micro-organisms tried; it is fermented to only a limited extent by these organisms. C. C. TAN: Identification of the salivary gland chromosomes in *Drosophila pseudo-obscura*. CURT STERN: The behaviour of unstable genic loci—a hypothesis. The unstable locus is assumed to be a composite of a gene in its normal locus and its mutant allelomorph laterally attached next to it, the effect being different from that produced when the two genes are located in different chromosomes. J. T. BUCHHOLZ, A. F. BLAKESLEE and A. G. AVERY: Pollen-tube growth of a translocation of the 1·2 chromosome in *Datura*. Translocation was produced by exposure of pollen tubes to radon during their passage through the style. Reduction in rate of growth of pollen tubes from plants carrying the extra chromosomal material appears to occur and is roughly proportional to the amount of extra material present. CHESTER STOCK: Insectivora from the Sespe uppermost Eocene, California. S. LEFSCHETZ: Application of chain-deformations to critical points and extremals. J. W. ALEXANDER: Note on Pontrjagin's topological theorem of duality. SUMNER BYRON MYERS: Connexions between differential geometry and topology. A. G. MARSHAK: The sensitive-volume of the meiotic chromonemata of *Gasteria* as determined by irradiation with X-rays. The inflorescence of *Gasteria* provides a regular sequence of buds, so that the effect of irradiation can be determined at various periods after exposure. The frequency of effects are proportional to dosage of radiation. Using Glocker's equation for the number of photo-electrons traversing a given volume, and measuring the volume of the nucleus and bivalent chromosome of *Gasteria*, the observed frequency of induced abnormalities enables the width of the sensitive portion of the half-chromosome to be estimated and eventually that of the single chromatid. The figures obtained agree well with those obtained from the diameters of simple protein molecules. R. E. BOWEN: Movement of sensory hairs in the ear. The author has previously reported movements of hair in the ear of the catfish. Observations are now recorded of regular movements of the sensory hairs in the ears of two marine teleostian fish, the squirrel fish and the striped grunt.

Forthcoming Events

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

Sunday, July 21

BRITISH MUSEUM (NATURAL HISTORY) at 3 and 4.30.—Mr. M. A. Phillips: "British Mammals".

INTERNATIONAL SOCIETY OF EXPERIMENTAL PHONETICS, July 22–26.—Meeting to be held in London. One joint session to be held with the second International Congress of the Phonetic Sciences.

ELECTRODEPOSITION EXHIBITION, at the Science Museum, South Kensington, July 25–October.

July 25, at 3.—Opening by Lord Melchett.

Official Publications Received

Great Britain and Ireland

Poison Gas. Pp. 64. (London: Union of Democratic Control.) 6*d*.

University of London Council for Psychical Investigation. Bulletin 1: Supplement to Short-Title Catalogue of Works on Psychical Research, Alleged Abnormal Phenomena, Spiritualism, Magic, Witchcraft, Legerdemain, Charlatanism and Astrology, from 1472 A.D. to the Present Time. Compiled by Harry Price. Pp. 112. (London: University of London Council for Psychical Investigation.) 2*s*. 6*d*. net.

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1934. Pp. 24. (London: H.M. Stationery Office.) 6*d*. net.

Report on the Phenological Observations in the British Isles from December 1933 to November 1934. By J. Edmund Clark, Ivan D. Margary and C. J. P. Cave. (No. 44.) (Quarterly Journal of the Royal Meteorological Society, No. 260, Vol. 61.) Pp. 231–284. (London: Royal Meteorological Society.) 3*s*.

Other Countries

India Meteorological Department. Scientific Notes, Vol. 6, No. 63: Wind Data for Wind Mills. By V. Doraiswamy Iyer. Pp. 57–85+7 plates. (Delhi: Manager of Publications.) 1.6 rupees; 2*s*. 3*d*.

Smithsonian Miscellaneous Collections. Vol. 93, No. 6: Ear Exostoses. By Aleš Hrdlička. (Publication 3296.) Pp. iv+100+5 plates. Vol. 94, No. 2: Concerning the Badianus Manuscript, an Aztec Herbal, "Codex Barberini, Latin 241" (Vatican Library). By Emily Walcott Emmart. (Publication 3329.) Pp. iii+14+4 plates. Vol. 94, No. 3: Thomas Lincoln Casey and the Casey Collection of Coleoptera. By L. L. Buchanan. (Publication 3330.) Pp. iv+15+1 plate. (Washington, D.C.: Smithsonian Institution.)

U.S. Treasury Department: Public Health Service. Time Distribution of Common Colds and its relation to corresponding Weather Conditions. By Mary Gover, Lowell J. Reed and Selwyn D. Collins. (Reprint No. 1634 from the Public Health Reports.) Pp. 14. 5 cents. Further Studies on Growth and the Economic Depression: a Comparison of Weight and Weight Increments of Elementary-School Children in 1921–27 and in 1933–34. By Dr. Carroll E. Palmer. (Reprint No. 1660 from the Public Health Reports.) Pp. 17. 5 cents. (Washington, D.C.: Government Printing Office.)

Bulletin of Yale University. Report of the Director of Peabody Museum for the Academic Year 1933–1934. Pp. 35. (New Haven, Conn.: Yale University.)

U.S. Department of the Interior: Office of Education. Bulletin, 1934, No. 19: The Problem of Duplication as attacked in certain State Surveys of Higher Education. By John H. McNeely. Pp. v+50. 5 cents. Leaflet No. 45: Federal Grants for Education, 1933–34. By Timon Covert. Pp. 14. 5 cents. Pamphlet No. 61: Per Capita Costs in City Schools, 1933–34. By Lulu Mae Comstock. Pp. 19. 5 cents. (Washington, D.C.: Government Printing Office.)

Field Museum of Natural History. Publication 346: Culture Areas of Nigeria. By Wilfrid D. Hambly. (Frederick H. Rawson—Field Museum Ethnological Expedition to West Africa, 1929–30.) (Anthropological Series, Vol. 21, No. 3.) Pp. 363–502+plates 93–160. (Chicago: Field Museum of Natural History.) 2 dollars.

Proceedings of the American Academy of Arts and Sciences. Vol. 70, No. 3: Measurements of certain Electrical Resistances, Compressibilities and Thermal Expansions to 20,000 kg./cm^2. By P. W. Bridgman. Pp. 71–101. 75 cents. Vol. 70, No. 4: The Lower Permian Insects of Kansas. Part 7: The Order Protoperlaria. By Frank M. Carpenter. Pp. 103–146+2 plates. 90 cents. (Boston, Mass.: American Academy of Arts and Sciences.)

Reports of the Institute for Science of Labour. No. 25: General Intelligence Test and its Norm. 1: Standardization of Intelligence Tests for Children, Adolescents and Adults; 2: Mental Development of the Japanese. By Dr. Hôken Kirihara. Pp. 22. 50 sen. No. 26: A Study of the Physical Sport-Types of the Japanese. By Dr. Takatugu Yagi. Pp. 17. 30 sen. No. 27: Experimental Studies on the Day and Night Inversion of Daily Routine. By Dr. Tomoyosi Isikawa. (Supplemental Report to the No. 3 Report.) Pp. 14. 30 sen. No. 28: Rafraichometer, an Instrument for Measuring Atmospheric Cooling Power. By Dr. Syuzô Eda and Dr. Sinzi Katuki. Pp. 9. 25 sen. No. 29: 1. Sex-Ratio in the Population of Japan Proper; 2. The Influence of Industrialism upon the Mortality of Young People and Adults. By Dr. Sinzi Katuki. Pp. 30. 60 sen. No. 30: Adaptation and Revision of Non-Verbal Will-Temperament Test. By Dr. Hoken Kirihara. Pp. 14. 30 sen. (Kurasiki: Institute for Science of Labour.)