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Science, Industry and Society

ALTHOUGH the recent annual report of the Department of Scientific and Industrial Research, an article on which appears elsewhere in this issue, contains much evidence of the increasing readiness of industry in Great Britain to make use of scientific method and scientific knowledge, particularly in the progress of the Research Association movement, the Advisory Council does not regard the position of the Research Associations as a whole as satisfactory, and points out that adequate advantage is not yet being taken of the grant offered. This warning has since been reiterated from the industrial side in respect of the woollen industry by Mr. D. R. H. Wilkins, a leading Huddersfield worsted manufacturer, in proposing a vote of thanks to Dr. J. B. Speakman for a lecture to the Huddersfield Textile Society on "The Chemist and the Mill" on February 22. Mr. Wilkins referred strongly to the short-sightedness of those textile firms which justified reluctance to finance research by arguing either that they were doing well enough without it or that they are not doing well enough to afford it.

The woollen industry is one of the two specially mentioned by the Advisory Council as having failed to provide the initial subscription to their Research Associations to qualify for the substantial block grant offered by the Department. The reluctance of this industry to finance research on an adequate scale is the more surprising in view of the admirable work that is already being carried out by its Research Association at Torridon with limited resources, and of the important fundamental discoveries on the chemical and physical structure of wool which have been made at the neighbouring University of Leeds in recent years. Such reluctance, however, gives further point to the emphasis which the Advisory Council lays on organizing the conduct of research so as to promote contact with industry.

From the point of view of industry, the report urges, research is only a means to an end—the application of scientific knowledge to all the stages of production, and the development of new processes. The application and development of scientific ideas in industry depend upon a complete understanding of the way in which industry can make use of science and scientific method, and this can only be achieved if the problem of co-operation is studied by the man of science as well as by the industrialist. The differences of experience, training and outlook between men of scientific education and many others engaged in productive industry are not always considered by those who are anxious to secure the potential benefits which science, wisely used, can bring to the community. The scientific worker has to meet the industrialist half way, and an important task of the Department of Scientific and Industrial Research is to assist the organization of such contact.

This question of co-operation, in one or other of its aspects, is probably the most important confronting industry and science to-day. It is not merely a matter of promoting contact between industry and science in such a way as to stimulate research in industries where it is at present comparatively neglected. The problem of promoting the application of science varies from industry to industry, partly by reason of the nature of the industry, partly by reason of its traditions and of the extent to which it has engaged the services of men of scientific training in its direction and its

productive effort. The first step is, however, that of getting the industrialist to state his problems to the man of science, and to determine the order of priority, in terms of their economic importance, of the objectives of particular proposals for research.

The contribution which science can make to the solution of industrial problems depends on persevering effort on the part of industry and close co-operation between the industry and science. In this sphere, the staff of a research association can often make an invaluable contribution through their knowledge alike of the day-to-day problems of the industry and of science.

The statement of the problems concerned is important if the best method of attack is to be selected, because for industrial purposes to-day that may involve consideration not merely in terms of a particular science but also of a combination of sciences. Moreover, it may even involve consideration and attack from the point of view of several industries, if the fullest resources are to be utilized and the best results obtained. This, as the Advisory Council points out, is probably the most significant development in the industrial outlook in Great Britain in recent years.

The last five years have witnessed the fruition of the policy adopted by several large industrial undertakings of setting well-balanced teams of research workers including chemists, physicists, engineers, biologists or entomologists, and others to solve a particular problem or to develop a new product. To this method of attack are due the steady improvement in the efficiency of electric lamps, the position Great Britain has won in high-definition television, the commercial development of the conversion of coal into oil by hydrogenation, the growth of the plastics industry, etc. Great Britain has never been lacking in men of genius whose inventive capacity can give birth to the ideas which bring about industrial advances. What is new in the country is the way in which industry has taken up these new ideas, and brought them to the stage of industrial development by team work in which all the departments comprising a great business have worked side by side in the practical attainment of an objective.

For economic reasons, as well as because of the high degree of specialization which the advance of knowledge has made inevitable in scientific fields, the future no longer lies with industries that are content to make advances at the call of the brilliant investigator. Co-operation, team work and an extensive organization are essential for success. Further, the exploration of the borderland of different sciences which is facilitated and stimulated by such team work has proved, as so often happens in the history of science, provocative of new ideas and fundamental advances in knowledge. For this reason we need not fear that team work in research, if wisely organized and directed, need stifle individuality or cramp initiative or creative thought, as has been suggested in some quarters. Such dangers undoubtedly exist, but can easily be avoided by prudent management. Moreover, there is yet a third aspect of co-operation to which attention is directed, not merely by the report of the Department of Scientific and Industrial Research, but also by the recent appeal on behalf of the University of Oxford.

Among the examples of co-operative research to which the Advisory Council directs particular attention are the developments in building research and the formation of consultative groups in food investigation. The new Fire Testing Station which has been opened at Elstree represents the outcome of co-operation between the Building Research Station and the Fire Offices' Committee and indirectly the British Standards Institution, while similarly the Heating Laboratory which has been erected at the Building Research Station represents the outcome of substantial contributions from industry through the Institution of Heating and Ventilating Engineers. Again, the consultative groups which are being established by the Food Investigation Board are intended to assist in establishing a community of interest in the increase of scientific and technical knowledge through the whole range of industries concerned, whether production, transport, storage, marketing and retail distribution. The first of these groups has been established for the shipping industry and has proved highly successful, greatly facilitating discussions between the staff of the Department and representatives of the shipping companies on the many problems connected with the carriage of foodstuffs overseas and also arrangements for full-scale trials of modifications in existing practice.

It would be easy, however, to multiply examples of the way in which co-ordination of the research activities of different industries is required in the attack on problems of common interest, or of the way in which only by some measures of co-operative research between different industries or Departments of State can effective attack be made on problems of general national welfare and interest. What is, however, now emerging is the desirability

of co-ordination of research effort in an even wider field if the best results are to be reaped from available resources.

This factor alone gives pertinence in this connexion to the recent appeal on behalf of the University of Oxford for £500,000 for each of two research funds. Advances in scientific knowledge make ever more onerous the task of schools of science, medicine and social studies in keeping abreast of the needs of an age of rapid material and technical development, and in making adequate provision for advanced studies and post-graduate research. Moreover, the very advances in natural sciences, with the concomitant calls for funds for erecting new laboratories or extending existing ones, equipping and staffing them, and for improving the facilities for research in the various science departments including the provision of research posts, only strengthen the claims for further funds for the better organization and extension of research in the humane subjects, particularly provision for the study of human society and allied subjects such as anthropology.

What is clear is that we have reached a stage when it is imperative to take stock of the nation's resources and facilities for research, both academic and industrial. To neglect or starve research is to invite national peril, but the danger of unbalanced development in certain fields while others remain scarcely explored is too great to be ignored. Some means of securing a better distribution of the national effort in research is indeed long overdue, and such distribution must take due account of all research activities and facilities, whether by the Departments of State, at the universities or within industry. To such a national stocktaking the Department of Scientific and Industrial Research might well make a decisive and indispensable contribution. Few organizations are in a better position to encourage the prosecution within industry itself of intensive research in the applied and physical sciences, with all the important reactions which such research continually has on the technique and outlook of the underlying sciences themselves. The relations between academic and industrial research in the physical sciences at the present time, the extent to which progress depends on team work, independent of whether the investigation is prosecuted within the university or within industry, the inspiration and assistance which academic and industrial research in these fields are continually bringing to one another, give fundamental research in the physical sciences special claims upon the support of industry, apart from the rapidity with which discoveries in this field are applied to industrial purposes. If the main burden of research in such fields were accepted by industrial resources, it should be possible to redistribute research facilities at the universities so as to endow much more liberally that research in the social sciences which is so urgently needed if we are to attain an understanding of the problems of society, its organization and adaptation to the forces playing upon it to-day, whether within industry or outside it. Without such understanding there is dire peril that the riches with which scientific knowledge could endow us even now may never be enjoyed.

Urgent as is this problem, it is not one to be solved in a few months or perhaps even a few years. A wide vision and a generous spirit are demanded of all who seek to co-ordinate research resources and endowments in any such way, and if we are to attain to wise direction of research it will come first through the bringing together of many authorities concerned, in much the same way as the Food Investigation Board has brought together the scattered interests concerned in its problems in the consultative groups to which we have referred. To restrain research in a narrow or partisan spirit is to endanger its finest quality and inspiration. Neither to natural science nor to the science of civilization can money be wisely grudged, and the distribution between the two can only be determined safely by minds inspired by the same vision of what may be achieved by skilled workers, governed only by the truth that makes them free, and in their turn the guardians of the intellectual integrity and freedom that have prompted famous donations to learning in the past.

No degree of co-operation, no excellence of team work will avail us if such direction does aught to impair the power of the university to promote and maintain true liberty of thought, which to-day is so seriously threatened in many quarters. It is only when, in that sense, the university not merely inspires the progress of civilization but also defends it, that we can expect free play for the creative thought upon which progress everywhere depends, alike in the study of the urgent practical problems of government and social life, human and international relations and in the fundamental problems continually brought before the scientific worker by industry.

Mme. Curie's Swan Song

Radioactivité
Par Madame Pierre Curie. Pp. iii +564 +26 plates. (Paris : Hermann et Cie., 1935.) 150 francs.

THE fundamental new property of radioactivity, discovered by M. Henri Becquerel in 1896 in the course of a re-examination of the fluorescence of uranium salts, a subject in which both his father and his grandfather before him had been pioneers, was in itself a remarkable example of scientific genius running in families. It was followed two years later by the discovery of radium and other new naturally radioactive elements, a million-fold more active than uranium, by Mme. Curie and her husband, which has made her one of the most famous women of the age, if not of all time. She died in July 1934, in the same year as, though happily not before, her daughter, Mme. Joliot-Curie, and son-in-law, M. Joliot, had made another fundamental step forward by the discovery of artificial radioactivity, the more notable as until then the aloofness of radioactivity from all external influences and the impossibility either of altering it in the natural radio-elements or imitating it in the inactive elements had been easily its most outstanding characteristic.

Under bombardment by suitable high-speed atomic projectiles many, if not most, of the common inactive elements can be made to give an evanescent radioactivity. This had often been tried before, without success, and the advance was entirely due to the almost incredible delicacy of modern single-atom methods coupled with the power of the valve to magnify these infinitesimal effects almost without limit. But since for this purpose, though the original discovery was made with the natural α-rays of polonium, artificially generated projectiles serve, they again may be multiplied by suitable electric generators almost without limit. So that already the monopoly of radium in its main practical use in therapy is threatened ; radio-sodium obtained by bombarding common salt with heavy hydrogen atoms, which has a half-period of 15·5 hours, has already been prepared comparable in activity to the naturally radioactive elements, and the price of radium has in consequence notably diminished.

Thus Mme. Curie died just as her daughter and son-in-law, in turn, had broken through the barrier which guards the future, and this handing on of the torch of discovery from father to son and from mother to daughter, which it would be difficult to parallel in the history of science, is peculiarly appropriate in the science that first showed that even the chemical elements are not immune from the processes of birth and death.

At the time of her death, Mme. Curie had just finished a new book on radioactivity, and this now appears posthumously after having been prepared for the press by her daughter and son-in-law—a little tardily, perhaps, as the date 1935 appears on the title-page. It is in one volume, about half the length of her much-esteemed "Traité de Radioactivité" of 1910, and is expressly intended for the student rather than the specialist, covering the lecture courses she had given at the Sorbonne. Part 1, occupying about one fourth the whole, deals with ionization of gases, cathode-, X- and positive rays, and it is not until Chapter vii that radioactivity is commenced. The disadvantages of this are, in my view, very serious. For the student is taken in detail through, for example, all the work subsequent to the Great War on isotopes by the positive-ray method and a great number of other topics inspired by and often arising directly out of the progress of radioactivity before the War, before any mention even is made of the parent subject. To make matters worse, when he does arrive at the second part, he is plunged into all the details of radioactive *families*, the formulæ governing the accumulation of radioactive matter, the isotopic constitution of the radio-elements, without any preliminary account of atomic disintegration, the evolution of the chemistry of the radio-elements and the idea of isotopes, or, indeed, any general conspectus of what radioactivity is, except what he already knows from popular hearsay or the study of earlier works.

Chacun à son goût. The beginner to-day has little enough time or breath for what is never going to be the subject of an examination question. He gets here in five hundred pages a careful and clear description of a many-sided subject, copiously illustrated with a large number of striking radiographs both of the earlier and later single-atom methods of examining these new radiations. Rarely can those to whom the task of writing such books usually falls claim to be as intimately versed in the subject. It is a monument to the indefatigability of modern scientists, to whom nothing is too trivial for elaboration, nothing so infinitesimal that it cannot be magnified into investigability. But from another point of view it is also a tombstone of what was once a living subject, erected as a guide to the budding licentiate to satisfy

the examination system. It sacrifices historical to logical order and the convenience of treating each section as it arises comprehensively so that it need not be reverted to. It is somewhat disconcerting to find that a subject so new and upsetting has already arrived at the stage of being just one more burden on an overloaded curriculum, all the more so as it is one in which the general principles only are essential, and these belong to the fundamentals of all physical science. It is the ideas, their evolution and the form in which they first appear to the human consciousness that it is most important to preserve; the rest is technics.

If we go back forty years to when Mme. Curie began her work, though chemists at least had a clear idea of the difference between atoms and molecules, the very existence of such energy as will keep her radium alight undimmed for centuries after she has gone was not even suspected, transmutation was universally shunned as an ancient chimera, prominently connected with fraud, and the chemical elements in all seriousness were regarded as homogeneous. It may be convenient to derive everything from the theories that grow up afterwards concerning the constitution of the atom, whatever these may happen at the moment to be, but these are the consequences of new knowledge, whereas it is the origins which should have the first attention of the would-be discoverer. Admittedly it is more difficult to convey to the student the general idea of fog, uncertainty and incomplete knowledge out of which discoveries take their rise. The modern theory has it all so pat and glib, though the truth is stranger than fiction.

If in the space of a lifetime the history of discovery can be so completely inverted or forgotten, one wonders sometimes whether there is any truth at all in what passes for the history of more remote events. It is fortunate that in this field the subject has entered on a new lease of life with the discovery of artificial radioactivity, and that Mme. Curie's last book may prove to be not merely the end of an epoch but also the beginning of a new one, so felicitously begun by her own daughter. *La reine est morte. Vive la reine!*

FREDERICK SODDY.

Earthquakes

Earthquakes
By N. H. Heck. Pp. xi+222. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1936.) 16*s*. net.

ON the concluding page, the author gives the titles of some text-books on general seismology that have been published in the United States, England and Germany. As the last of them dates from 1923, there is clearly room for a new book in which the more recent advances in our knowledge are described. The author is the chief of the Division of Terrestrial Magnetism and Seismology of the United States Coast and Geodectic Survey, and he is therefore in constant touch with the important work that is being carried on in the United States and especially in the State of California.

As the book is designed for the general reader in the United States, the examples and illustrations of the various phenomena are naturally drawn from the earthquakes in that country, especially from such great earthquakes as those of New Madrid in 1811 and 1812, the Owens Valley in 1872, Alaska in 1899, and California in 1906. While this, to a certain extent, increases the usefulness of the book for the European student of seismology, in another sense it somewhat narrows its scope, for, even in these great earthquakes, certain phenomena were inconspicuous, such as the seismic seawaves and the long trains of after-shocks that are connected with the earthquakes of other lands. These subjects are referred to indeed, but too briefly to be of much service.

With these exceptions, the ground is well and carefully covered, the phenomena are clearly described and most of the illustrations are excellent. Among the chapters of greatest interest are those on the causes of earthquakes, including what are known in the United States as 'trigger forces'—a term that it is to be hoped will never become current in Great Britain—on earthquake study with instruments, with good descriptions and illustrations of recently made seismographs, on earthquake records and their interpretation, the location of earthquake epicentres and foci, and on regional investigations in the United States, a chapter that occupies nearly one fifth of the book.

Two other chapters are welcome innovations in the usual text-book course. In that headed "Descriptions of Great Earthquakes", are given brief accounts of seventeen disastrous shocks since

1755, accounts that in most cases furnish the main facts, though omitting the remarkable seiches of the Lisbon earthquake of 1755 that were observed in the lakes of Scandinavia and the north of Scotland. Again, the last chapter contains a brief summary of the "History of Seismology", beginning with the work of John Michell—a most useful feature. In a new edition, the names of seven workers that are wrongly spelled should be corrected. C. D.

A Colour Code for Biology

Code universel des couleurs
Par E. Séguy. (Encyclopédie pratique du naturaliste, Vol. 30.) Pp. lxviii+55 plates. (Paris: Paul Lechevalier, 1936.) 60 francs.

WE have many times collected flowers and animals for our scientific friends. They have always been insistent that we should note their colours. For this purpose we have lately used a colour chart sold by a well-known philatelic shop, but, in resulting publications, we have observed that our colour terms are seldom accepted. Now a French entomologist presents us with a seriously thought out colour-code, founded on the three basic colours, blue, red and yellow, which, when mixed as on a rotating disk, may be made to yield all the colours of the spectrum.

This code covers 48 plates with 15 tints on each, numbered 1 to 720, and the colours may be conveniently quoted by number which, if desired, can be preceded by the spectral terminology for the series. Cover-slip sheets with a suitable aperture through which to view the colours are provided, and it is advised to use the same, choosing a slip of a colour complementary to that of the shade isolated. An example is given, a coloured plate showing three kinds of water-lilies: "Feuilles: vert 388—Fleur supérieure: blanche—Au milieu à gauche: *Nuphar luteus*, fleur, jaune 257—A droite et en bas: *Nymphæa hortorum*, fleur, face supérieure des pétales, rouge 154, face inférieure, rouge 181."

The reviewer's determinations work out better by daylight than by artificial light, and with a white slip rather than with those of the complementary colours. Tested with *Chrysanthemum* petals and some butterflies, our results were distinctly good, each object being laid on the coverlip alongside the shades of colour in rotation. As a practical example, consider a few of the various blues which may be mentioned by artists and scientific men—and let the reader decide whether he is capable of determining all these with accuracy from isolated specimens: turquoise, jade, Antwerp, Gentian, sky, marine, flax, peacock, cyanine, swallow, steel, ultramarine, lavender, royal and Prussian. All are fairly clear on the charts, but the last four are blue-violets.

Great credit is due to the publisher in the production of these charts, and, if necessary, they can obviously be repeated. The physicist has his own methods of enumerating colours, but the naturalist demands something simpler. If he requires the greatest accuracy, would it not be worth his while, whether botanist or zoologist, to test out this code—and if approved ask for its official adoption wherever possible? Any normal individual of reasonable intelligence can very quickly master its use, and thus save himself and his correspondents worry and doubt.

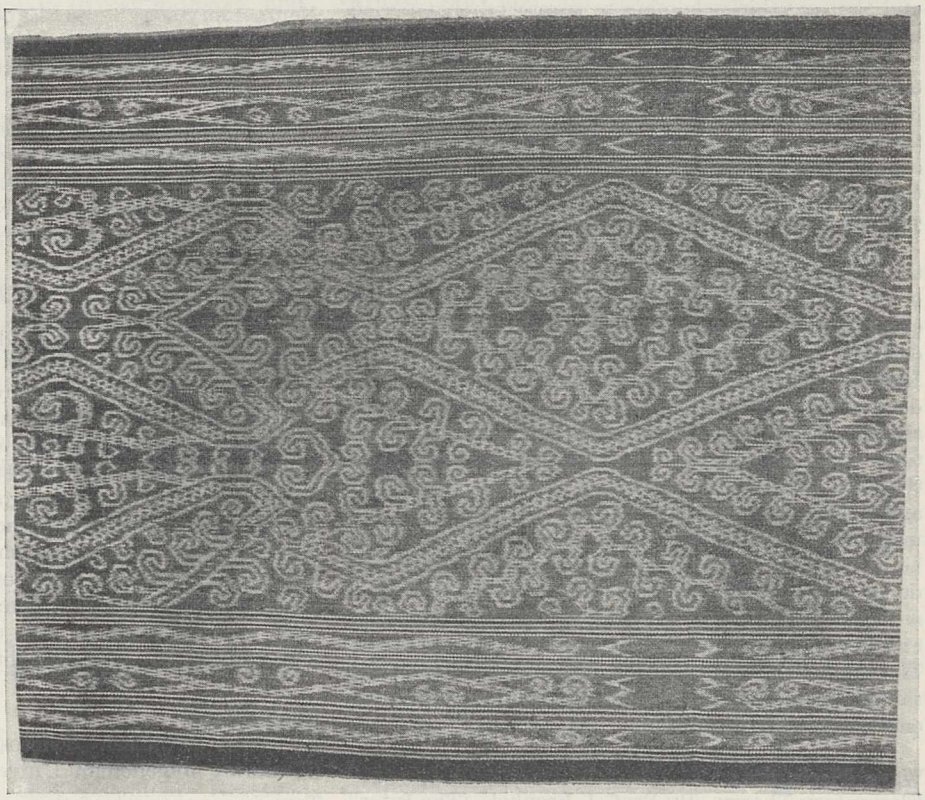
Sea Dayak Textiles

Iban or Sea Dayak Fabrics and their Patterns: a Descriptive Catalogue of the Iban Fabrics in the Museum of Archaeology and Ethnology, Cambridge. By Alfred C. Haddon and Laura E. Start. Pp. xv+157+36 plates. (Cambridge: At the University Press, 1936.) 25*s*. net.

IN this volume Dr. Haddon has returned to one of his early interests, the decorative art of a less advanced community. We are given a study of the designs and patterns on the specimens forming the Cambridge and British Museum collections of Iban (Sea Dayak) cloths, of which the best known and most numerous are the petticoats worn by women. These are always highly patterned, the designs being for the most part so conventionalized that it is impossible to tell what they represent by mere examination. The identification, that is, naming, of the elements of design on the cloths of both collections is due to the late Charles Hose. These are taken as authoritative, and it is upon them that the work is based.

The Iban are a smart, rather dressy people, and both sexes are fond of ornament; the women are expert weavers, producing their complicated and admirably spaced patterns with no other guide than knowledge of conventional design and appreciation of the space to be covered. They have rather a full palette of colours, red, yellow, blue, black, brown and white all being included.

As to the designs themselves, these represent men, crocodiles, deer, shrews, birds, spiders, centipedes, leeches, scorpions, various insects, and plant designs, besides natural phenomena such as clouds. To these must be added a minority of patterns derived from objects of everyday life. All, with the exception of the anthropomorphs (which include a few designs called frogs) and the crocodiles, are so conventionalized as to be unrecognizable without expert instruction.



WOMAN'S PETTICOAT, REDDISH-BROWN AND BUFF, WITH PATTERN CONSISTING OF PLANT DERIVATIVES. FROM "IBAN OR SEA DAYAK FABRICS AND THEIR PATTERNS"

An example rather simpler than most is reproduced herewith. This cloth is just over 4 feet long and 21 inches broad. Most of the patterns are derived from plants. The background is reddish brown and the patterns upon it are in buff. The main pattern is edged on each side with three longitudinal stripes in varied colours, with a narrow almost black border at the outer edge. About two thirds of the length of the cloth, including that portion shown in the figure, is mainly occupied by a lozenge-shaped arrangement of the branches of the *tangkong* with its "flowers" (*bunga tangkong*) in the centre of the lozenge. Other portions of the design represent *pating betula*, "branches pushing one another back", and *daun tangkong mulai*, "leaf of the *tangkong* twisted back", as well as other plant derivatives. About one third of the cloth (not shown in the figure) has a somewhat degenerate deer pattern, with strikingly developed antler derivatives. The borders consist of two stripes of *daun wi*, "tendrils of ratan", with between them one line of *entibap* (*Arenga saccharifera*).

Thirty-six plates are devoted to illustrating the designs, as well as a number of the cloths themselves. Turning these over, the reader is immediately struck by the absence of obvious foreign influence. Apart from a few deer designs, which probably are not dragon derivatives, though it might be possible to construe them as such, there is nothing that can be ascribed to foreign intrusion, a rather remarkable fact considering the Chinese influence that has been exerted in Sarawak. It will be remembered that the most characteristic art products of the Iban men—the carved bamboo cylinders designed to hold needles and other trifles—are ornamented mainly with somewhat stylized plant designs, and that again Chinese elements are absent. All this seems to bring the decorative art of the Iban into strong contrast with that of some other Borneo tribes. The designs must then be regarded as definitely Iban in origin, and a consideration of the objects represented will convince the reader that the authors are right in tracing many of them to the omen animals which play so large a part in Iban religion.

C. G. SELIGMAN.

The Hero:
a Study in Tradition, Myth and Drama. By Lord Raglan. Pp. xi+311. (London: Methuen and Co., Ltd., 1936.) 10*s*. 6*d*. net.

In this volume, Lord Raglan extends to a wider field the application of certain critical principles which he formulated in his presidential address to Section H (Anthropology) of the British Association. He denies the validity of the methods by which tradition is made the ground of inference as to events in the past, of which documentary evidence, literary or archæological, has not survived. He maintains that tradition, still less the elusive "folk memory", does not endure for more than at most one hundred and fifty years, and that anything claiming to transcend that period is fictitious.

Lord Raglan is not content to rest in destructive criticism. He passes on to show how the 'standardized' heroic traditions came into being. They are, he holds, the concrete part of a ritual, which in most instances can be seen to underlie them, and when regarded at this angle, conforms to the pattern of fertility and cognate rites of an early form of community.

Lord Raglan argues his case ably and well. At the same time, there is something to be said in favour of tradition. Lord Nelson and Napoleon did exist, even though they may appear side by side with the entirely imaginary characters of the folk-drama. Lord Raglan, presumably, would feel constrained to deny their existence, if documentary evidence were absent. That the argument from tradition has sometimes been carried to absurd lengths does not alter the fact that it has served as a useful pointer in archæological argument, as, for example, in the instance of Crete, Troy and other sites of Greek heroic legend. Often such legends must be taken as doing no more than provide the archæologist with a *memoria technica* for cultural movements, contacts and development revealed by archæological research. The argument from tradition, like many other useful things, including Lord Raglan's counter, must be employed with discretion.

Wave Mechanics:
Elementary Theory. By Prof. J. Frenkel. (The International Series of Monographs on Physics.) Second edition. Pp. x+312. (London: The Oxford University Press, 1936.) 20*s*. net.

This new edition needs little introduction to readers of Nature. For the benefit of those who have not studied it, it may be said at once that it is one of the best introductions to wave mechanics extant—complete in itself, clear in development, and not overburdened with mathematical symbolism. The seven sections into which the book is divided deal respectively with light, matter, wave mechanics of a particle, wave mechanics of a system of particles, statistical mechanics, applications to metal theory, heat motion and radiation, and the last section, which is new, is concerned with the theory of chemical forces. Small errors and misprints have been eliminated. The word 'elementary' must not be misunderstood, as, although mathematical developments are not over-emphasized, the work cannot be read with profit by a student who does not possess that knowledge of mathematics necessary to a student of physics of honours grade.

"A little philosophy inclineth Man's mind to atheism; but depth in philosophy bringeth men's minds about to religion." So far Bacon; and some of the enthusiasts who have made far-reaching, and possibly hurried, deductions from Heisenberg's uncertainty principle, might profitably consider the brief, but important section in which Prof. Frenkel deals with Heisenberg's theory of the uncertainty relation to the role of the observer.

Neuroembryology:
Neuroembryology: an Experimental Study. By Prof. S. R. Detwiler. (Experimental Biology Series.) Pp. x+218. (New York: The Macmillan Co., 1936.) 16*s*. net.

A book which gives the exact position of a research subject is always valuable, provided it is accompanied as here by a full literature list. It discusses the factors influencing the growth of nerves, the proliferation of nerve cells and the capacity of the nervous system to adapt itself in response to changed conditions. By experimentation, imposed upon a knowledge of the morphological changes, the dynamics of the developing organism are studied. The data are collected by the examination of the effects in regeneration, by surgical means and by grafting, these leading to hypotheses of the agencies underlying the normal architecture; here the work of Ross Harrison in the last forty years is highly distinguished. Then later there is the study of the growth of nerves *in vitro*, which favours mechanical factors rather than those dependent on hormones, chemotaxis or electrical agents. The whole story of the use and present position of the subject is here told in a pleasant and easy manner, such as will undoubtedly encourage new workers to enter this difficult field.

Ebulliometry
By Prof. Wojciech Świętosławski. Pp. x+196. (Krakow: Jagellonian University Press, 1936.)

This is an account of the method of precise boiling point measurements based on the Cottrell principle which has been developed by Prof. Świętosławski and his students since 1925 and applied to a number of physico-chemical problems. Numerous forms of apparatus are described with full experimental details, and this monograph should be useful in directing attention to an experimental technique which has perhaps not yet been recognized in Great Britain at its true worth.

It is a little unfortunate that the translator appears to be more familiar with the idiom of the French language than with English; thus it requires a moment's thought to reveal the significance of "dosing vessels". In general, however, the meaning is clear, and this monograph will be valued not only for its detailed exposition of the experimental methods but also for the discussion of a wide range of scientific and technical problems in which boiling point methods can be used. S. S.

Progressive Science in Public Welfare and Modern Industry*

THE Department of Scientific and Industrial Research now occupies such an essential place in the scientific and industrial structure of the country that it is already hard to realize that it is little more than twenty years since it first came into existence. The recently issued twenty-first annual report of the Department indicates the remarkable success of the Department in stimulating a new outlook in British industry, and can point to welcome evidence of increased support for research from a considerable number of industries in the last year. The most admirable feature of the report, however, is the lucid and comprehensive picture it gives of the contribution of science to the service of the needs, not merely of industry but also of every aspect of our daily lives, whether as a nation or as private citizens. From the requirements of the defence forces and other Departments of State, to the primary needs of the humblest citizen in respect of water supply, food, transport, clothing and recreation there is scarcely a question to which some contribution is not made by the Department. Moreover, the growing complexity of many of the issues involved in some questions, as food supply, national defence, roads and road safety, render the more valuable such a comprehensive picture as is regularly afforded by the annual report of the Department.

The present report, which covers the period October 1, 1935–September 20, 1936, contains the brief report of the Committee of the Privy Council, signed by the Right Hon. J. Ramsay MacDonald, Lord President of the Council, the report of the Advisory Council, over Lord Rutherford's signature and summaries of the work of the National Physical Laboratory, the Chemical Research Laboratory, and of the various research associations, and research boards or committees.

The gross expenditure of the Department in 1935–36 was £787,186, or £571,831 net as against £549,751 net in 1934–35. The largest single item of expenditure was £109,038 on the National Physical Laboratory, the gross expenditure of £234,383 covering, however, the cost of work carried out at the Laboratory for the Food Investigation Board, the Radio Research Board, and other Research Boards of the Department. Against this gross total, receipts amounted to £125,345, of which £65,950 represents fees from industry for paid work. Other receipts against the gross expenditure of the Department include £63,878 in payments by other Government departments for services rendered, £32,623 from the Road Fund and £9,800 from the Empire overseas for food investigation. Expenditure on the Chemical Research Laboratory was £21,697, on food investigation £43,296 net, on building and road research £78,218 gross, or £33,655 net, on forest products research £38,983 net, on fuel research £87,501 net and on water pollution research £13,968 gross or £4,354 net. Expenditure on the Geological Survey and Museum amounted to £66,641 net, while grants to Research Associations amounted to £108,951 as against £85,384 in 1934–35 and £58,992 in 1933–34.

Special stress is laid in the report on the progress of the Research Associations, and encouraging evidence of development in this field is the increased contribution of the industries concerned to the support of these associations. In the three years since the Million Fund came to an end in 1932–33, this figure has grown from £167,370 to £232,468, and the erection of further buildings and the extension of equipment which have marked the past year indicate the growing faith of industry in the value of research. New laboratories of the Electrical Research Association costing more than £29,000 were opened at Perivale. The Research and Standardisation Committee of the Institution of Automobile Engineers—the co-operative research organization of the motor industry—has acquired and equipped new laboratories costing £20,000 on the Great West Road. The laboratory accommodation of the Paint Research Association has been considerably enlarged. Extensions involving expenditure of £41,000 have been opened at the Shirley Institute (cotton research), where the buildings now cover an area of more than three acres and the total cost of laboratories and equipments has passed £200,000. The income of the Cotton Research Association, the largest of the research associations, has now reached £84,000 and its staff last year numbered 270.

The position of the research association movement as a whole is not, however, regarded as entirely satisfactory. The Department is prepared to provide a further £66,000 for the support of the Research Associations, and would have found that sum in each of the last two years had industry been ready to provide an equivalent contribution. In fact, had full advantage been taken of the offer of the Department, the income of the associations would have been increased by a further £150,000 a year. In some cases only two years

* Department of Scientific and Industrial Research. Report for the Year 1935–36. (Cmd. 5350.) Pp. iv+195. (London: H.M. Stationery Office, 1937.) 3s. net.

now remain in which the industry can earn the balance of additional grant still available. A new development in the year has been the conversion of the Printing Research Association from merely an efficient information bureau, serving the printing industry, the paper-making industry and the printing ink manufacturers, into an organization which adds to knowledge by research. Additional staff has been engaged, and laboratory premises, opened by H.R.H. the Duke of Gloucester on March 9 of this year, have been equipped.

To turn from the prosaic survey of ways and means to results achieved, it is almost startling that industry anywhere should be so backward in supporting the work of the Research Associations, which makes such important contributions not only to industrial welfare but also to social amenities and well-being. The examination by the Iron and Steel Industrial Research Council of data of works operation, for example, has led to a rapid improvement in productive efficiency and reduction of fuel consumption even in works which were regarded as highly efficient. Moreover, the greatly increased control by scientific instruments in steel making has led to robust apparatus of high precision for such work being made by British firms at prices competitive with foreign apparatus. A comprehensive investigation on steel sheet has been initiated in co-operation with the research organization of the automobile industry. The British Non-Ferrous Metals Research Association has continued its work on the corrosion of copper with particular reference to water service pipes as well as that on the corrosion of lead.

Mainly as a result of the work of the British Refractories Research Association, the life of the silica brick linings of gas retorts is now 25 per cent longer than ten years ago, and the economies resulting to the gas industry are very large. The Electrical Research Association has developed a new type of fuse for radio receivers or electrical clocks which combines a close degree of protection with a greatly increased time lag. Other of its work has been concerned with interference with broadcasting from electric appliances in common use, and with earthing conditions for overhead lines which will protect cattle grazing under them from shock if faults develop on the lines. An interesting investigation carried out by the Paint Research Association of particular interest to the householder is that of painting in winter and in wet weather, and of methods of overcoming the difficulties or ill-effects due to such conditions by simple modification in the composition of the paint.

The close bearing of the work of the Research Associations on everyday life is indeed remarkably illustrated in the present report. A community which is making ever greater use of the motor-car, whether for private or for public transport, can scarcely fail to appreciate the importance of the co-operative research which has made cylinder wear in automobiles no longer the serious problem it presented a few years ago. Gas masks are unfortunately now presenting a civilian interest as well as an industrial interest or one confined to the defence forces of the Crown, but the importance of the work of the Rubber Research Association in developing durable rubber components for such masks and in devising tests to ensure that supplies of reliable articles are available is obvious. Equally of interest, in view of the increasing use which is made of rubber as a constructional material in buildings, is work on the development of rubbers resistant to fire and heat.

Work on rubber is related to comfort as well as to safety, however, and the Association has also been investigating methods of measuring the hardness of rubber which will enable its cushioning properties in reducing noise and vibration to be evaluated more accurately. A particularly interesting piece of work of the Association has been concerned with the resistance to wear of rubber soles and heels, which has enabled the durability of rubber footwear to be increased. The Leather Manufacturers' Research Association has also been concerned with footwear, and has undertaken an important investigation on the quality of sole bands for shoe manufacturers with special reference to the suitability of the leather for light stuck-on soles. The boot, shoe and allied trades have their own Research Association, however, and this has been responsible for an outstanding development in what may be called the initiation of research on walking. To assist manufacturers to design better fitting shoes, the Association has devised a means of making very careful records of the way in which various people walk. A cinematograph record is taken by means of a moving platform or treadmill of the movements of the foot, and is afterwards carefully analysed. The gaits of individuals and the effect of different kinds of shoe upon them are being investigated, and the results already obtained suggest that some shoes are much more likely than others to interfere with the usual gait. The significance of such a contribution from the point of health is difficult to assess, but may well be of great importance.

Equally significant is the work of the Flour Millers' Research Association on the keeping qualities of bread. What the housewife calls 'staling' is usually due to poor keeping qualities in the bread. Bread made in the best possible way from the best possible flour will retain its edibility for ten or twelve days, whereas bread improperly made from poor flour may become

unappetizing and almost uneatable in two or three days. The work already carried out suggests that if more attention were paid to commercially controllable factors which promote the good keeping quality of bread, the question of stale bread would be much less serious.

This aspect of bread staling is not, however, true staling, which is caused by a change in the nature of the starch in the bread from its natural form at high temperatures to the natural form stable at low temperatures. If true staling could be prevented, the bread would probably always keep well, but, in practice, methods which would prevent the transformation are liable to accelerate the growth of moulds. Other work of the Association has been concerned with the storage of flour and the fats of flour, while the Research Association for the Cocoa, Chocolate, Sugar, Confectionery and Jam Trades has been investigating the problem of the attack of starch products by insect pests and has already been of much assistance in the suppression of such pests. Other work of this Association on the jellifying properties of various pectins has led to the improvement of conditions for the manufacture of marmalade from oranges.

Many other investigations on food problems, particularly those relating to the storage and transport of food, for which the Food Investigation Board is responsible, are referred to in the report. At the Low Temperature Research Station at Cambridge the lethal effect of X-rays on bacteria has been studied in connexion with the storage of meat. Methods of storing eggs in different concentrations of carbon dioxide are being tried out on a large scale. Another investigation is concerned with the relation between the quality of pork and bacon and the growth and diet of the pig ; and the advantage in dry salt cures of resting the pig adequately before slaughter has been established. The storage and salt curing of herrings, the gas storage of apples, pears and other fruits and vegetables, and canning questions, are other examples of the way in which the work of the Department is tending to improve food supplies and assist in questions of adequate and balanced diet.

Nor are boots and shoes the only point at which the work of the Department touches the clothing of the citizen. The work of all the textile research associations bears closely upon many such matters. The new silk section of the Cotton Research Association, for example, is contributing materially to the solution of problems involved in the use of mixed fabrics of cotton, silk and rayon. The Linen Research Association has been concerned with the laundering of linen fabrics and their resistance to weathering and to fading when dyed, while besides its important work on the resistance of wool to shrinking the Woollen Industries Research Association has been responsible for fundamental research now widely exploited in the 'permanent waving' of ladies' hair. The housewife should be equally appreciative of the work of the Launderers' Research Association on the washing of woollens, on the development of fastness standards for coloured goods and on the properties of detergent solutions.

Reference has already been made to contributions made by the Department in matters of safety. No aspect of the work of the Colliery Users' Research Association is more important than this, whether in respect of dust suppression and the prevention of silicosis, underground illumination or the control of atmospheric conditions in mines. An important investigation has been commenced at the National Physical Laboratory on the production of static electrification in operating theatres of hospitals, which should enable the risks of ignition of anæsthetics by sparking to be considerably reduced. A preliminary investigation on the similar risk in dry-cleaning works has been undertaken at the request of the Home Office.

Among other work bearing directly on health and safety may be mentioned that on industrial respirators and the detection of toxic gases in industry, research on the composition of dental amalgams, their manufacture and use, the radium treatment of disease, atmospheric pollution, in which field a survey on a large scale of the pollution in and round the City of Leicester is to be undertaken, and the investigations in chemotherapy at the Chemical Research Laboratory. Moreover, at the present time, the significance of much of the work of the Road Research Board, whether in road construction or road usage, such as questions of skidding and its prevention, needs no emphasis in this connexion. Work on water pollution, too, has yielded results as important from the health point of view as from that of the considerable savings which have been achieved, for example, for the dairy and milk industry, through the improved disposal of their effluents.

The Building Research Station is scarcely of less importance to the householder than to industry, and besides the improvement of bricks and cements, the durability of building stone and the structure and strength of materials, has covered questions of fire prevention, for which purpose a Fire Testing Station has been opened, and the efficacy of buildings from the point of view of users as regards heating, ventilation, lighting, or the transmission of noise.

The Illumination Research Board has been concerned not only with lighting, or such problems as the effect of glare on vision, but also with problems in connexion with automobile headlights. Space does not permit even mention of other

investigations carried out at the National Physical Laboratory or at the Chemical Research Laboratory, by the Forest Products Research Station, the Fuel Research Station, the Lubrication Research Board, in metallurgical matters, furnace design, aircraft design and other fields which have yielded equally significant results for industry or the general advantage of the community. A final reference can only be made to the discovery in radio research, which is one of the most interesting of the year, of the existence of three new electrified regions in the atmosphere between 4 and 40 miles above the earth. These regions are thus well below the well-known Heaviside and Appleton regions, which play such an important part in broadcasting to great distances and in making Empire communication on short waves possible.

Enough has been said, however, to demonstrate the value of the work of the Department alike in the latest fields of scientific activity and investigation and in the very oldest on which industrial prosperity and civic welfare alike depend. No document could in fact be better calculated to show the contribution which scientific research can make to human welfare and progress if it is applied to constructive and social ends, and not prostituted for destructive purposes as in preparations for war.

Boron and the Control of Plant Disease

By Dr. Winifred E. Brenchley

THE value of boron in improving plant growth was indicated in the early part of this century by various workers, notably Agulhon[1], but it was not until 1923 that its essential nature was definitely proved by Warington[2] in her work on the broad bean. Since then, research workers and practical men have taken up the matter all over the world, and various obscure physiological diseases of crops have been traced to a deficiency of boron in the soil. Crown rot of sugar beet, raan in swedes, topsiekte of tobacco and certain leaf-roll diseases of potato all respond favourably to the application of small dressings of borax, usually ranging from 10 lb. to 20 lb. per acre for these relatively short-lived plants. Heavy dressings of boron compounds are unfavourable as they produce toxic symptoms which may cause grave damage.

During the last few years, active experimental work has been carried out in widely separated centres on the control of cork disease, corky core, or internal cork of apples, all apparently representing the same trouble. The surface of the fruit becomes uneven, and brown areas of diseased tissue are distributed throughout the apple, particularly around the core, greatly reducing the market value of the crop.

Acting on a suspicion that the disease was due to the deficiency of some essential element, McLarty[3] tested thirty chemicals by injecting them into the trunks of affected trees. Of these, boric acid and manganese borate proved effective in controlling corky core, as with injections above a minimum of 1·83 gm. per 100 sq. cm. of the cross-sectional area of the trunks no disease occurred, and the total crop was greatly increased. Heavier doses up to 5·92 gm. did not cause any damage to the foliage, though there was slight injury to the bark and cambium at the point of injection. In these experiments the test material was nearly always packed into the trunks in the dry form, because of the greater convenience in handling and also because larger amounts could be used without injury to the foliage.

At the same time, Askew and his collaborators in New Zealand[4] and Jamalainen[5] in Finland were also investigating the problem. In New Zealand boron again proved to be the effective controlling agent out of a large number of elements tested, and the method of getting it into the tree seems to be largely a matter of convenience. Borax spread broadcast at the rate of ½–1 lb. per tree or 50–100 lb. per acre rapidly penetrates the soil to the absorbing zone of the roots in a favourably moist season, and is taken up and passed into the leaves and fruit, giving good control of internal cork. The penetration might not be so good or rapid in a dry season, but there is a considerable safety margin, as the normal annual requirement per acre for leaf and fruit growth has been found by analysis to be only about 14 oz. of borax. Injections of solution containing 0·25 per cent of hydrated borax were equally effective in increasing the boron content of leaves and fruit, and internal cork was prevented by so little as 2·5 gm. borax per tree. Where the injections were made into a branch, a certain amount of migration of boron took place into untreated branches, even when the point of injection was some way above the crotch. Similar control was obtained by applying borax sprays at the rate of one gallon per tree, and the suggestion is made that two applications

of a 0·25 per cent solution in spring at an interval of three weeks would prove useful in commercial practice.

In the Finnish experiments[5], boric acid was used as well as borax, and smaller quantities were also tested and proved effective in the control of cork disease. This may be due to a combination of factors, including the type of soil, the different climatic conditions and the fact that the boron compound was watered into the soil. The size of the trees is not indicated, and it is possible that the Finnish trees were younger and smaller than those in New Zealand and so responded to a lower dressing.

Boron deficiency not only damages the tissue of the fruit but also affects the chemical composition, as Jamalainen found that diseased apples contain more glucose and fructose than saccharose, and that the carbohydrates of the actual diseased tissues remain in the starch stage and are not converted. The striking similarity in the results obtained in different parts of the world afford conclusive proof of the value of boron in the control of corky core in apples, and gives rise to the hope that other obscure diseases of fruit trees may also prove to be due to deficiency of some essential minor element, which can be supplied at a relatively low cost and without undue difficulty.

[1] Agulhon, H., "Recherches sur la présence et le rôle du bore chez les végetaux", Thèse, Paris (1910).

[2] Warington, K., "The Effect of Boric Acid on the Broad Bean and certain other Plants", *Ann. Bot.*, **37**, 629–72 (1923).

[3] McLarty, H. R., "Tree Injections with Boron and other Materials as a Control for Drought spot and Corky Core of Apple", *Sci. Agric.*, 16, 12, 625 (Aug. 1936).

[4] Askew, H. O., Chittenden, E., Thomson, R. H. K., and Atkinson, J. D., "The Use of Borax in the Control of 'Internal Cork' of Apples". *New Zealand J. Sci. Tech.*, **18**, 365 (1936).

[5] Jamalainen, E. A., "On Cork Disease of the Apple and on its Appearance in Finland", *J. Sci. Agric. Soc. Finland*, **8**, 24–35 (1936). "The Effect of Boron on the Occurrence of Cork Disease in Apples", *Agric. Expt. Activities of the State*, Pub. 89, pp. 11 (1936) (English summaries).

Obituary Notices

Mr. William Taylor, O.B.E., F.R.S.

WILLIAM TAYLOR, who died at the age of seventy-one years on February 27, showed a bent towards engineering early in life, making his own lathe at an age when most children are playing with toys. He learnt from the village blacksmith and the local wheelwright. His first schoolmaster was Dr. Richard Wormald of London, a pioneer in the teaching of science, at whose lectures he assisted as demonstrator. The school was so far advanced in its methods as to have a workshop for metal and wood work. At this time, William and his brother made in their workshop at home, which they had themselves built, a pair of the first telephones ever made in England, and one of the first copies of Edison's recently invented tinfoil phonograph. Later, William Taylor was one of the first students at the Finsbury Technical College, his teachers being Profs. H. E. Armstrong, Ayrton and Perry. He made for Ayrton and Perry the model of their ammeter which is now in the Science Museum. Some of the instruments made in his student days are still in use at the factory he started in conjunction with his brother. The firm thus founded in 1886 was known at first as T. S. and W. Taylor, and afterwards as Taylor, Taylor and Hobson. The founders had the unusual experience of celebrating last year the jubilee of the business they had established.

The firm started by manufacturing photographic lenses, and William Taylor soon saw that accurate lens manufacture depended on accurate screws, so he invented methods of measuring the essential dimensions of screws with a micrometer, using cylinders placed between the threads; he then found it necessary to make his own screw-cutting lathes to produce threads of the necessary accuracy. He also invented the abrupt thread to facilitate the engagement of the lens in its flange. The Royal Photographic Society had proposed standard flange screws, but at first the manufacturers were antagonistic and the Taylor firm was the only one with the necessary equipment to conform to these standards. This experience in exact workmanship was invaluable in the manufacture of the anastigmat, when, in consequence of the reputation of the brothers, they were offered the manufacture of the Cooke lens, the first anastigmat of English design. The inventor of this lens, H. Dennis Taylor, was not related to William Taylor.

In the manufacture of photographic lenses, the need was felt for speedier and neater methods of engraving the mounts than was possible by hand; this led to the design of the engraving machine which, originally intended only for use in Taylor's own works, quickly found a market outside and greatly enhanced the reputation of the firm.

William Taylor next turned his attention to improving the methods of glass working, and practically revolutionized the process of making lenses, so that it became possible to manufacture them in quantity and of high quality. Machines were made for sawing the glass, cutting out disks, roughing to shape, smoothing and polishing, and finally edging. In the design of the automatic grinder, Taylor's work was fundamental. The iron tool fed with loose abrasive, as previously used, quickly lost its shape. He saw that by using a cup-shaped abrasive wheel—he secured one of the first to arrive in Great Britain—any curvature could be produced on the glass by varying the angle between the axes of the revolving work

and that of the wheel; wear would not alter the curvature, and could be compensated by moving the wheel forward along its axis.

Great Britain reaped the harvest of these improvements during the Great War, but William Taylor's services did not end there; he made precision tools for munition making (one of the screw thread measuring machines is now in the Science Museum) and redesigned, entirely on his own responsibility, the Army clinometer, so that it was possible to make two hundred weekly of the new design against twenty of the old. In 1919, Taylor, Taylor and Hobson's was one of two Leicester factories which were visited by Their Majesties King George V and Queen Mary.

Mr. Taylor's chief hobby was golf, and he was accustomed to think over and sometimes solve his engineering problems while on the links. He soon became interested in the manufacture of golf balls, adapting his engraving machine to the engraving of golf ball moulds. He himself invented several patterns of markings, and with characteristic thoroughness made a golf ball driving machine to test balls scientifically. A further extension of the engraving machine was the recently invented electric etcher to make possible the marking of hardened steel surfaces quickly and neatly.

Mr. Taylor served on many standardization committees, and obtained a patent for a system of screw thread gauges which he gave to the British Standards Institution for the benefit of the public. This was the foundation of the well-known Wickman gauge. He was also interested in the training of the young engineer and did much, by offering prizes, to encourage a high standard of craftsmanship among apprentices. He gave freely of his time and advice also to Leicester and Loughborough Colleges.

Mr. Taylor took a patriarchal interest in the welfare of his workers and maintained close personal contact with them. His essential kindliness was perhaps masked by a certain dignity, but the employee who might at first feel rather like a schoolboy before the headmaster would soon see the twinkle in his eye as a humorous sally was made, or one of his large store of apt anecdotes was related. It is worth while recording that 'daylight saving' was in operation at his factory years before the Daylight Saving Act. After the War, he introduced a scheme of co-partnership. In his earlier years he had been a Liberal and Free Trader, but modified his views after the War and became a firm supporter of the League of Industry, one of the first branches being started in his works.

Among the honours that fell to William Taylor—all too few in view of his achievements—were the award of the O.B.E., the presidency of the Institution of Mechanical Engineers (in the year of the Ottawa Conference, at which he represented the Institution), and the fellowship of the Royal Society. He was a member of the general board and of the executive committee of the National Physical Laboratory. He was a clear thinker, a good speaker, most thorough in his work, with a passion for accuracy, good design and good craftsmanship. He had a firm belief in the mechanization of industry as ultimately good for the craftsman and craftsmanship, relieving the operator of monotonous physical labour, setting him a higher standard of accuracy, and leaving him more time for the work that calls for the exercise of his higher faculties in the art and science of his craft; the time saved entailing further work in furnishing the instruments of education and recreation, thus providing unlimited progressive development. H. W. L.

Mr. A. R. Horwood

BY the death of Arthur Reginald Horwood, on February 21, British botanists have lost a valued colleague and friend.

Horwood was born at Leicester on May 29, 1879, and was trained for the Indian Civil Service. He failed, however, to pass the medical examination and in 1902 he obtained a post at the Leicester Museum; he was afterwards appointed sub-curator and resigned this post in 1922. Two years later he was appointed temporary botanist at the Royal Botanic Gardens, Kew, and remained at the Herbarium until his death.

Horwood's chief botanical work was concerned with fossil plants and the flora of Europe and the Near East. He published many papers and books, and his popular works on the British flora obtained a wide circulation. The best-known of these were "Plant Life in the British Isles" (3 vols. 1914–16), and "The Outdoor Botanist" (1920). His most important publication was "The Flora of Leicester and Rutland" (1933), written in collaboration with the late (third) Earl of Gainsborough. This contains a large amount of ecological information based on the extensive surveys that Horwood carried out with a band of helpers while at the Leicester Museum. At Kew, Horwood worked in the European and Oriental Department and was chiefly engaged in naming collections of plants from Persia, Iraq and other countries in the Near East.

Horwood was always willing to give the benefit of his advice and help to his many botanical friends and correspondents. He was twice married and leaves a widow and four sons.

WE regret to announce the following deaths:

Sir James Currie, K.C.M.G., K.B.E., chairman of the governing body of the Imperial College of Tropical Agriculture, Trinidad, and director of the Empire Cotton Growing Corporation, on March 17, aged sixty-eight years.

Prof. E. C. Franklin, emeritus professor of organic chemistry in Stanford University, known for his work on ammonia compounds, on February 4, aged seventy-four years.

Prof. J. A. Gilruth, formerly professor of veterinary pathology in the University of Melbourne, lately chief of the Division of Animal Health of the Commonwealth Council for Scientific and Industrial Research, on March 4, aged sixty-six years.

Prof. Duncan S. Johnson, professor of botany in the Johns Hopkins University, on February 16, aged sixty-nine years.

News and Views

Dr. H. L. Eason, C.B., C.M.G.

DR. HERBERT LIGHTFOOT EASON, who has been appointed principal of the University of London, in succession to the late Sir Edwin Deller, was educated at University College, London, and at Guy's Hospital. He has been superintendent of Guy's Hospital since 1920, having previously held the post of dean of the Medical School from 1904 until 1912. He has been a member of the Senate since 1911 and has been vice-chancellor since 1935. He was chairman of the Library Committee in 1929–33, of the Finance Committee in 1923–25, and of the Academic Council for two periods (1922–23 and 1933–35). He served during the Great War as consulting ophthalmic surgeon to the Forces in the Mediterranean, Egypt and Palestine, was mentioned in dispatches, and was awarded the C.M.G. in 1917 and the C.B. in 1919. He has been the representative of the University on the General Medical Council since 1925, and is now junior treasurer of the Council. From 1924 until 1926 he was a member of the Departmental Committee of the Board of Education on the re-constitution of the University, and from 1925 until 1930 a member of the Departmental Committee of the Ministry of Health on Postgraduate Medical Education.

Prof. J. A. Douglas

DR. J. A. DOUGLAS, of Keble College, for many years senior lecturer and demonstrator in the Department of Geology at Oxford, has been appointed to the chair in succession to the late Prof. W. J. Sollas. The professorship carries with it a fellowship at University College. Prof. Douglas's most important work is his classical contribution to the geology of the Andes. He has also done important work on Persian palæontology and stratigraphy, especially the Permo-Carboniferous fauna of south-west Persia. He had published many papers on local geology, especially on the cornbrash sequence of the British Isles, and on other subjects. He has served both as secretary and vice-president of the Geological Society. Generations of students of geology at Oxford have known him as a good teacher—both as tutor and lecturer—and an expert in field geology. The appointment is a popular one, and one that augurs well for the future of geology in the University.

The Flooding in East Anglia

ALTHOUGH on a much smaller scale than the tragic experiences along the valleys of the Rivers Ohio and Mississippi in the United States, and happily, so far, unattended by any loss of life, though the damage to property has been considerable, the flooding of the Fen District in East Anglia has been a source of great anxiety and distress to the unfortunate inhabitants and a matter of grave concern to the responsible authorities. The situation, continuously critical, has changed its aspect but little from day to day during the past week or ten days, except to demonstrate fresh localities of weakness in the over-strained banks of the rivers. Cracks and breaches have occurred at various points and, at the time of writing, some 15,000 acres of good cornland lie under water, while another 150,000–180,000 acres are threatened with a similar fate. The district lies in the South Level area of the Great Ouse Catchment Board, which includes Ely, Soham and Burwell on the east and Earith on the west, forming a basin drained by the Cam, the Lark and the Little Ouse and minor streams. At the moment, the chief source of anxiety is transferred to two main watercourses, the Old and the New Bedford Rivers, artificial channels of the Great Ouse from Earith to the estuary, constructed by Sir Cornelius Vermuyden in the seventeenth century. The two channels run almost parallel about three quarters of a mile apart for a distance of twenty-one miles, and the intervening space, known as the 'Washes', provides a relief for the channels when overcharged, being flooded regularly in the winter and occasionally in the summer months. The two main, or barrier, banks of the enclosure protect the low-lying land on each side, and the maintenance of these banks is a matter of vital importance. The banks are now being taxed to the limit of their resistance.

The Special Areas Act

THE statement relating to the Special Areas, including the memorandum on the financial resolution proposed in the House of Commons on March 8, reviews the work of the Commissioners and the progress in the Areas in public health, social and other services, trading estates, development of industrial and shipping facilities and of the Special Areas Reconstruction Association (Cmd. 5386. London: H.M. Stationery Office). The paper states that the placing of Government orders and the establishment of Government factories in the Special Areas, together with the prospective improvement in the rate position, have prepared the way for a further advance. To assist the introduction into the Areas of new industrial undertakings of the 'light' type and provide more stable, because more diversified, employment, the financial resolution provides the necessary authority for the introduction of a Bill to continue in operation the Special Areas (Development and Improvement) Act after May 31, 1937, to extend the powers of the Commissioners under that Act, and to make new provisions as regards Special Areas and certain other areas to be certified by the Ministry of Labour.

It is proposed to extend the present Act and additional provisions until March 31, 1939, and the resolution provides for the facilitation of the establishment of industry by authorizing the Commissioners to let factories in the Special Areas. It also authorizes the Commissioners to contribute for periods not exceeding five years, not only towards income tax and rates, but also towards the rent payable in respect of new industrial undertakings. Assistance is also to be given to Site Companies established to provide factories in the Areas, and provision is made for loans not to exceed £2,000,000 in the aggregate to new undertakings for their establishment in the Areas. These proposals and the resolution led to a lively debate in which the Government accepted the Opposition suggestion of a Select Committee. Neither the Statement nor the Minister of Labour's speech indicated any rational extension of the boundaries of the Special Areas or redress of existing anomalies, and they are also silent on the questions of training labour and the improvement of communications in the Special Areas.

Transmutation of the Heavy Elements

AT the Friday evening discourse before the Royal Institution on March 19, Lord Rutherford discussed "The Transmutation of the Heavy Elements". During the last few years, our knowledge of the transmutation of the elements by artificial methods has grown with great rapidity, and practically all the known elements have been found capable of transmutation on a small scale when bombarded by fast particles of suitable type. The bombardment of bismuth by fast deuterons is of particular interest as it leads to the production of a radioactive isotope of that element identical in radioactive and chemical properties with the natural radioactive body, radium E. This important result has been confirmed by showing that this artificially produced radium E gives rise to polonium—the first of the radioactive elements separated by Mme. Curie in 1897 from uranium minerals. In general, the neutron is extraordinarily effective in producing transformations in the majority of the elements. In a number of cases very slow neutrons are far more efficient in this respect than fast ones. A suitable source of neutrons for such experiments can be obtained by bombarding beryllium with α-particles from radium. The fast neutrons can be slowed down by allowing them to pass through material containing hydrogen, for example, water or paraffin. In this way more than eighty new radioactive isotopes have been discovered, most of which break up with the emission of β-particles.

THE action of neutrons on the heaviest known element, uranium, has been the subject of close study by Hahn and Meitner during the past two years. Work with this element presents special difficulties on account of its spontaneous radioactivity. The trans-uranic elements produced by neutrons have chemical properties similar to those to be expected from eka-rhenium, eka-osmium, eka-iridium and eka-platinum, corresponding to elements of atomic numbers 93, 94, 95 and 96 respectively. Three new radioactive series are formed, two of which probably arise from the main isotope of uranium (mass 238) after the capture of a neutron, and the third may be due to a less abundant isotope of uranium (mass 235). It does not appear that the bombardment of uranium by neutrons has any effect in accelerating the natural disintegration of this element. A complex series of transformations also arises when the second heaviest element, thorium, is bombarded by neutrons.

Rusting of a Meteorite

EVER since the largest of the meteoric irons found at Cranbourne, about thirty miles south-east of Melbourne in Australia, was extracted from the sand in which it had lain buried for numberless years, it has shown a pronounced tendency to rust. This large mass, which weighed about 3½ tons, was presented to the Trustees of the British Museum in 1862. When first received, it was mounted on a turntable and was shown uncased. So rapid, however, was the rusting that within a short time it was decided to place it in a glazed case and keep the air within as dry as possible by means of frequently renewed supplies of lime. The effect was to slow up markedly the rate of rusting, but not to stay it altogether. It is estimated that more than 4 cwt. of rust has been removed from the meteorite since it reached the Museum. Arithmetically, therefore, it would appear as if the mass had a very long life before it, but it would have been nothing like so long because the lawrencite (ferric chloride), the cause of the mischief, is disseminated in seams and by expanding during alteration tends to split up the mass. Owing to the size and porous character of the meteorite, treatment by a surface coating which has proved so successful with other meteoric irons was out of the question.

ABOUT a year ago, the Trustees on the advice of the Keeper of Minerals decided to substitute for the ordinary glazed case an airtight one which could be filled with dry nitrogen. At the same time the original turntable was replaced by a stronger rigid structure and the mass provided with a firmer bed. During this process forty pounds weight of rust and scale was removed. The nitrogen supply, which is concealed under the bed by the mahogany panelling, consists of the usual cylinder and oil bubblers at the entrance and egress, an extra one at a higher pressure being provided for safety at the egress side. It is necessary to pass the gas slowly through the case because of the impossibility of assuring so large a one being absolutely airtight. The glass and metal are bound together by a special hard cement. A small panel fitted with a gasket has been provided on one of the short sides to give access to the interior when necessary. The first effect of the new method has been to cover the floor of the case with an unusual amount of dust and fragments, the reason being that they had previously been maintained in the cracks or on the surface by moisture which has now gone.

Standardization of Technique in Physical Anthropology

ONE result of the first International Congress of Anthropological and Ethnological Sciences, held in London in 1934, was the establishment of a permanent International Committee for Standardization of Technique in Physical Anthropology. Miss M. L. Tildesley was elected as chairman, and Prof. H. V. Vallois as secretary, until 1938. The records of the subject have been increasing rapidly in recent years, but it is now generally realized that many of the definitions used are not precise enough to ensure that independent workers will obtain metrical or other descriptions which are truly comparable. The techniques used in measuring living people are the least satisfactory, and in this case the personal equations of observers are large enough to falsify many inter-racial comparisons. Miss Tildesley has been making a grand tour in the interests of her committee, and in January she read a paper, entitled "The Problem of Internationally Standardizing Scientific Method", at the meeting of the Australian and New Zealand Association for the Advancement of Science held in Auckland. This dealt more with organization than with any results as yet achieved. The committee consists of 37 members representing 35 different countries, and it is claimed that the fact that it has no permanent seat is an advantage. Different sections of the work are delegated to small groups, and the members of these will be obliged to collaborate chiefly by correspondence. Resolutions of the committee are to be circulated in French versions, with translations in other languages if this is found necessary. An organization of this kind should bear good fruit, even if its principal achievement should be to persuade those who publish new material to give data which will make it possible to estimate the reliability of their records, such as repeated measurements on the same subjects.

John Buist and the Elementary Bodies of Vaccinia

IN the February issue of the *Edinburgh Medical Journal*, Dr. Mervyn Gordon directs attention to the work of Dr. John Buist of Edinburgh upon the microscopy of variola and vaccine lymph, which appears to have been lost sight of. In recent years evidence has accumulated that the minute agents of virus diseases such as smallpox, vaccinia and influenza, which are capable of passing through fine filters that stop the passage of ordinary bacteria, are particulate. In fact, it is possible to demonstrate tiny spherical or ovoid bodies in most virus diseases by means of dark-ground illumination, or after suitable staining by ordinary objectives. Their size usually lies between 0·1 μ and 0·2 μ, and they are arranged singly, in pairs, or in groups. These granules have been given the name of 'elementary bodies', and accumulated evidence suggests that they are the causal agent of the virus disease, particularly in vaccinia, in which they are frequently known as "Paschen bodies". In a book published in 1887 ("Vaccinia and Variola : a Study of their Life-History"), Buist describes and figures minute bodies which he observed in films of vaccine lymph after prolonged staining with aniline-water gentian violet. Dr. Gordon remarks that there can be little doubt that these bodies described and figured by John Buist (and regarded by him as being the contagium itself) are identical with those afterwards found by Paschen and others and known to-day as the elementary bodies of vaccinia and its causal agent. John Buist was a native of Fife, born in 1846, and was for a time medical superintendent of the smallpox hospital at Barrow-in-Furness. He died in Edinburgh in 1915.

Natural and Artificial Clouds

THE Symons Memorial Lecture was delivered before the Royal Meteorological Society on March 17, by Prof. D. Brunt, professor of Meteorology in the University of London, on the subject of "Natural and Artificial Clouds". Prof. Brunt pointed out that the motions which occur when an unstable layer of fluid breaks down have been found to be in the form of polygonal prismatic cells, in which the motion at the centre of the cell is upward, when the fluid is a liquid. In air, while the motions in deep layers resemble those in liquids, except that the direction of motion is reversed, the motion in shallow layers made unstable by heating from below consists of a large number of ascending currents, surrounded by much slower descending currents. When the air is bounded at its upper limit by a movable glass plate, the shearing produced by moving this plate will give long rolls extending through the whole length of the chamber, if the upper plate is moved sufficiently rapidly. With slower movements of the upper plate, the chamber is filled with distorted prismatic cells, and with very slow movements of the plate, the chamber is filled with rolls transverse to the direction of motion of the plate. These experimental results can be applied to explain a variety of cloud forms, which are thus presumably in part due to the effects of instability. Among these clouds are those which consist of small cloudlets on a background of blue sky, cloud sheets which show a series of clear holes, and clouds in rolls, which may be analogous to either the longitudinal rolls found in the laboratory with rapid shearing of the top plate, or to the transverse rolls found with slow shearing of the upper plate.

Erosion in the Punjab

A CONFERENCE held at Simla recently affords evidence that the importance of the erosion question in the outer Punjab Hills is now receiving serious attention. It was presided over by Sir Herbert Emerson, the other members consisting of the revenue member, the financial commissioner for development, three commissioners of divisions, two deputy commissioners, a representative of the Finance Department, a chief engineer of irrigation, the chief conservator of forests, the conservator of the Eastern Circle and the forest research officer. The assembly of so influential a body shows the importance now attached to this problem by Government. Yet the problem is not a new one. For the last four decades it has been discussed, and men

with wide vision have, years ago, foretold the inevitable waste and ruin which would result if the population were allowed to carry on certain practices, including the almost unrestricted pasturage of flocks, more especially goats. The Governments of the day turned a deaf ear. To-day the position has to be faced. Apart from the loss of valuable agricultural land resulting from serious erosion in the hills, part of the water supplies upon which the great network of canals in the Punjab plains depend will be jeopardized unless the extending erosion in the outer hills can be stayed. In several regions of the British Empire this problem of erosion on the large scale and the man-made desert are probably two of the most complicated and most important of the administrative and economic matters facing several Governments.

Education of Young Children

"YOUNG CHILDREN IN EUROPEAN COUNTRIES" is the title of a report recently issued (Washington, D.C.: Superintendent of Documents. Pp. 108. 15 cents) by the United States Office of Education. Among the *sequelæ* of the economic depression in that country none aroused greater concern than the physical and mental handicaps imposed upon young children, and emergency nursery schools were established in 1933–35 in nearly all the States; mostly in already existing school buildings but also in hospitals, camps, mines, mills, etc. As these schools proved their value, it became generally recognized that they had come to stay, and it was determined to ascertain what other countries were doing in this field. The senior specialist in nursery-kindergarten-primary education of the Office of Education was, accordingly, sent on a mission of inquiry to England, Scotland, Belgium, Holland, Italy, Austria, Hungary, Czechoslovakia, the Soviet Union and Poland. Hence the present report, which describes administrative and financial arrangements, housing and equipment and the training of nursery school teachers. In addition, the report deals with health and nutrition and family housing in relation to young children. In scientific planning for the staffing of nursery schools, the Soviet Union is pre-eminent with a network of institutes preparing the teachers who are to take care of the 3½ million children between three and seven years of age for whom nursery and infant schools are to be ready this year. Statistics of attendance in such schools in fourteen countries for 1934 show a maximum of 66 per cent of the population (ages 3–6) in Belgium. France comes next with 52 per cent.

Statistics concerning Non-manual Workers

THE Advisory Committee on Salaried Employees, set up by the International Labour Office at its meeting on November 18–19, reviewed statistics, compiled by the International Labour Office, relating to non-manual workers in different countries, which show the tendencies for the proportion of salaried employees to workers to rise in recent years, to which attention was recently directed at the British Association meeting by Mr. S. W. Stephen. The proportion of women among salaried workers has also risen markedly since before the Great War. In industrial countries, non-manual workers now represent 20–30 per cent of the occupied population. In noting the general tendencies, the Committee recommends that the International Labour Office should continue its studies in this field. Attention was also given to the question of notice of termination of contracts, and opinion was expressed that formal rules should be introduced in this respect in countries where they are not yet in existence. Such regulations should provide for a minimum period of notice to be given by the employer in accordance with the importance of the work performed or its remuneration. A report on the effects of the use of office machinery on conditions of work for staff was also considered, and measures for improving the standing of office employees and protecting them against some of the effects of mechanization were suggested. These suggestions cover essentially the type of work at present being carried out by the National Institute of Industrial Psychology, so far as its resources permit. The protection of the health of employees was also considered, attention being directed to the unsatisfactory conditions in many shops and offices, including warehouses and the premises of forwarding agents, from the point of view of the health, comfort and safety of the staff.

South African Herbage Crops

THE grasslands and forage crops of the British Dominions and Colonies have been the subject of various issues in the Herbage Publication Series, New Zealand and Australia being dealt with in Bulletins 11 and 14 respectively, while papers on research in India and Canada have appeared in *Herbage Reviews*. The most recent addition to this series published by the Herbage Bureau, Aberystwyth, is Bulletin 18 entitled, "Pastures and Forage Crops in South Africa" (Aberystwyth: Imperial Bureau of Plant Genetics. 3*s*.) in which contributions are made by such recognized authorities as I. B. Pole Evans, A. R. Saunders, J. W. Rowland and S. R. de Villiers. The four distinct types of natural pasture, namely, parkland, grassland, desert shrub and sclerophyllous bush are described in detail so that the special problems associated with each of them are clearly indicated. The discovery that the general decline in carrying capacity of the veld had resulted from faulty grazing management has led to a research programme being developed on national lines to enable the natural pastoral resources to be more efficiently utilized. At the same time, the progressive nature of the live-stock policy has brought the question of fodder crops to the fore, and more attention will have to be paid to the production of legumes in the future. The importance of breeding work is also recognized, and as a result of the intensive botanical survey recently undertaken, a large and valuable collection of indigenous grasses has been made. From this it is hoped to build up the types of herbage most suitable for the various districts, introduction of grasses from Europe or America being largely ruled out owing to the differences in climatic conditions.

Research at Apia Observatory

THE annual report for 1933 of the Apia Observatory, an institution which is controlled by the New Zealand Department of Scientific and Industrial Research, contains seismological, meteorological, magnetic and electrical data for Apia (western Samoa), and climatological summaries for a number of islands in the South Pacific. The electrical data refer to atmospheric electricity, and were obtained under the guidance of the Department of Terrestrial Magnetism at Washington, D.C., U.S.A., as in former years. They include observations made with Benndorf electrometers. A tide gauge was maintained, and copies of the tabular records were supplied to the United States Coast and Geodetic Survey at Washington. In the more ordinary meteorological work, seventy soundings were made with pilot balloons, to give information about the upper winds. Another activity in that section was the preparation of daily synoptic weather charts. The material for these was collected by Apia Radio Station. Twenty observing stations from various islands contributed to this, thus forming the nucleus of a synoptic network. Material of the kind included in this report forms the observational basis of text-books of world climatology, but the report keeps to the statistical type of presentation, no attempt being made to relate the results to those obtained in other parts of the world.

Cancer Research at the Franklin Institute

AN illustrated brochure has recently been published by the Biochemical Research Laboratories of the Franklin Institute, Philadelphia, describing the aims of the Foundation, which previously was known as the Cancer Research Laboratories. It is pointed out that research has extended from studies of cancer alone to other phases of life and disease, so that it appeared suitable that past research done on the cancer problem should be made an avenue of approach to the more general area of other diseases. The aims of the Foundation are the study of the processes of disease from a chemical point of view, the study of new organic chemical compounds with regard to their therapeutic, medicinal and beneficent values and the study of longevity and the diseases of age, with the hope of prolonging the span of life. The booklet points out that the investigators at the Institute work as a team, although grouped in the three departments of chemistry, physics and cytology: the director is Dr. Ellice McDonald. The library is an important feature of the Institute, with more than 16,000 classified reprints with author and subject reference. The brochure concludes with a list of 101 papers published during the past nine years from the Institute or the Cancer Research Laboratories.

Standards of Telephone Transmission

IN the Engineering Supplement to the *Siemens Magazine* of January, W. H. Grinsted discusses the problem of the standards used for the assessment of telephone transmission. The wide range of variation of many of the factors involved makes the problem a very complex one. The factors affecting transmission may be divided into the conditions associated with the users, including their own peculiarities, and the plant provided by the administration. Transmission is said to be satisfactory when two subscribers can converse without misunderstanding or strain. During the last four years, experiments have been made in the Siemens' laboratories on a method of transmission testing for 'satisfactoriness' based on this definition. Measurements of satisfactoriness are often made by sending speech to the limit of intelligibility or using nonsense syllables (logatomes), but neither represents conditions similar to normal operation. The latest American scheme is to use 'judgment observations', that is, personal preference as the criterion. The objection to this method is that different persons give very different reasons for preferring one circuit to another. In the method described by the author, the quality of the transmission is measured by noting the number of times that the listener's attention is diverted by the need for conscious effort to understand a word or phrase. The method is highly subjective, but this is necessary if it is to take into account some important factors. The limitations of the method are also discussed.

Universities and War

IN Great Britain there is some difference of opinion as to the purpose of university education. In Italy the question has been definitely settled. What follows is a translation of the beginning of the preface to "Nozioni di Balistica Esterna", by T. Levi-Civita and U. Amaldi (Zanichelli, Bologna, 1935): "The Supreme Council of Defence has requested that University programmes of studies in every subject shall comprise, as an integral part of the course, the theories that more directly concern Military Science and Technique; and in particular has pointed out the claims of External Ballistics to be included in the Theoretical Mechanics Course. We have accordingly thought it our duty to complete with this appendix our Compendium of Theoretical Mechanics (Zanichelli, Bologna, 1928), which has been drawn up to conform with the programme of a regular course at a University or Higher Engineering College. The Contents of this Appendix faithfully follow the programme suggested by the aforesaid Supreme Council of Defence. . . ." We should like to see the corresponding programmes for other subjects, including theology. Presumably that for literature would include Nietzche's dictum "Man is made for War . . . ; all else is folly".

Literature on Water and its Pollution

A VALUABLE summary of abstracts of current research upon water and its pollution, prepared by the Water Pollution Staff of the Department of Scientific and Industrial Research, is issued monthly. In the January number (**10**, No. 1, 1937. H.M. Stationery Office. Price 2*s*. net) the matter deals with a variety of subjects grouped under "Water Supplies", "Analysis and Examination of Water", "Sewage", "Trade Wastes" and "Pollution of Natural Waters". The abstracts are fair summaries of the original literature.

Telephone Loudspeakers for Group Conversations

WE learn from the Soviet Union Year Book Press Service that a telephone loudspeaker to enable several persons to take part in a telephone conversation has been designed by the radio and telephone workshop of the Moscow Province post office administration. The apparatus consists of a loudspeaker and microphone instead of the ordinary handset. The microphone can be placed at a distance of three feet or more from the persons taking part in the conversation. If desired also, several telephone lines can be connected with the apparatus at the same time. It is operated with 110–120 volts alternating current. Thirty of these new devices have already been made. It is not stated for what purposes they are intended. They might be useful for a teacher or lecturer who wanted to address several small classes simultaneously, although the classes were at considerable distances apart.

Radcliffe Travelling Fellow in Astronomy

FOLLOWING nomination by the University of Oxford, the Radcliffe Trustees have elected Dr. H. Zanstra, of the University of Amsterdam, to the post of Radcliffe travelling fellow in astronomy for the three-year period commencing October 1937. Dr. Zanstra, formerly a National Research Fellow in the United States, has held university posts at Seattle, the Imperial College, and Amsterdam, and has carried out observational work at the Dominion Astrophysical Observatory, Victoria. He is best known for his theory of the origin of nebular luminosity, for his observational determination of the temperatures of the nuclei of planetary nebulæ, and for his investigations of the effects of radiation pressure on the stability of nebulæ.

The Night Sky in April

BETWEEN April 1 and 30, the nights shorten in the latitude of London by nearly two hours. Summer Time comes into operation on April 18. New moon occurs on April 11 at $5{\cdot}2^{h}$ and full moon on April 25 at $15{\cdot}4^{h}$. If the evenings are clear, 'earthshine' on the moon may be observed from about April 13 until April 16. The planet Venus, which was conspicuous in the evening skies of last month, draws rapidly towards the sun's position until inferior conjunction takes place on April 18; next month it will be seen as a morning star. Mercury, which is usually rather a difficult object in the latitude of Great Britain for naked-eye observation, is at greatest eastern elongation (20° E.) on April 20. The planet is in conjunction with Venus on April 7 at 15^{h}. On April 12 at 8^{h} Mercury and Uranus are in conjunction, and at 12^{h} on the same day there is a conjunction between Mercury and the moon which is then just over a day 'old'. Mars rises before midnight and is placed not far from Antares. Jupiter is a morning star, rising at about $2\frac{1}{4}^{h}$ in the middle of the month. Saturn, rising in the dawn, is not conspicuous. By 22^{h} in mid-April, the winter constellations of Taurus, Orion, Canis Major and Canis Minor with their bright assembly of stars have nearly set in their entirety, whilst Vega has risen in the north-east, and Arcturus is about $2\frac{1}{2}$ hours east of the meridian. The constellations on or near the meridian at this time offer several attractive objects for telescopic observation—the bright double stars of γ Leonis (separation about 4″), *Castor* ($4\frac{1}{2}$″), ξ Ursæ Majoris (1″), γ Virginis (6″), and α Canum Venaticorum (20″). Messier 51 at R.A. $13^{h}\ 28^{m}$, Dec. $+47{\cdot}4°$ (epoch 1950), which is one of the best known spiral nebulæ, requires of course a large telescope and the photographic plate to resolve its structure. Messier 3 at R.A. $13^{h}\ 40^{m}$, Dec. $+28{\cdot}6°$ is a notable globular cluster 18′ in diameter, whilst the "Owl" planetary nebulæ (Messier 97) is at R.A. $11^{h}\ 12^{m}$, Dec. $55{\cdot}3°$. The Lyrid meteors may be looked for on and about April 21, their radiant being near the star 104 Herculis. The northern sky should be scanned for appearances of the aurora—more particularly when a large sunspot is crossing the sun's disk.

Announcements

MR. T. E. HARVEY (Independent Progressive) has been elected M.P. for the Combined English Universities in the by-election caused by the death of Sir Reginald Craddock. Mr. Harvey was formerly an assistant in the British Museum and warden of Toynbee Hall.

DR. H. J. MULLER, the distinguished Russian geneticist working with Prof. N. I. Vavilov, informs us that on March 15 he arrived at Valencia and was proceeding to Madrid for work with the Canadian blood transfusion unit. Dr. Muller states that he hopes to resume later the work in genetics which he had been carrying out in the Soviet Union, and which his colleagues there are continuing in his absence.

THE report of the Third Correlation Tour undertaken by the Soil Surveyors' Executive Committee has just been published by the Ministry of Agriculture, for England and Wales, and the Department of Agriculture for Scotland. The work of this committee is to correlate soil series examined and classified by soil surveyors in different parts of the country, and its third report refers particularly to the Bristol, Reading and West Midland Provinces and to Wales. Copies of the publication may be obtained gratis on application to the Ministry of Agriculture, 10 Whitehall Place, London, S.W.1.

THE Laboratory of Industrial Hygiene has been incorporated under the laws of the State of New York as a non-profit organization empowered to carry on scientific and industrial work in chemical, bacteriological and general public health problems, and to accept grants for definite scientific purposes. The president is Dr. William Hallock Park. The laboratory includes at the present time the following units: a certified milk laboratory under the direct supervision of Dr. Park, a vitamin-testing laboratory, a clinical diagnostic laboratory and chemical and bacteriological laboratories.

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. 553.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

New Knowledge of the Life-Cycle of Malaria Parasites

WE wish to direct attention in this letter to an interesting result of our work at this Institute on the malaria parasite of the domestic fowl, which Prof. Brumpt, of Paris, found and described in 1935 and to which he gave the name *Plasmodium gallinaceum*[1,2].

This parasite, like other members of the family Plasmodiidæ, has a schizogonic cycle of development in the circulating red blood corpuscles of its vertebrate host (the domestic fowl) and a sporogonic cycle of development in its insect host which, as Brumpt has shown, is the yellow fever mosquito *Stegomyia fasciata* (*Aedes aegypti*). But it appears from our work that it has, in addition, a hitherto unrecognized schizogonic cycle of development occurring in reticulo-endothelial cells of the spleen, liver, kidneys and other internal organs and particularly, in certain cases, in the reticulo-endothelial cells which line the capillaries of the brain.

The first step in this finding was that in January this year, one of us (S. P. J.) observed in the cytoplasm of endothelial cells from the spleen and heart blood of a chicken which had died from the malarial infection, unpigmented schizogonic phases of a parasite which bore no resemblance to the pigmented 'sporulating' or 'pre-sporulating' stages of the malaria parasite occurring in red blood corpuscles. Provisionally we called these phases "*x* bodies". Then a search of the literature showed that in 1935 Clay Huff and Bloom[3], of the University of Chicago had found what seemed to be the same phases in erythroblastic and lymphocytic cells of the bone marrow of birds infected with *Plasmodium elongatum*, and that in 1936 Prof. Raffaele[4] of the Marchiafava Institute for Malariology in Rome had found what are certainly the same phases in the reticulo-endothelial system of birds infected with *Plasmodium relictum*. The interpretations given to their findings by these observers are not at all the same, but this seems to us to be less important than is the fact that observers working independently in three different countries on three different species of avian plasmodia have found that at any rate some malaria parasites have an additional cycle of development in the vertebrate host which was previously unknown.

As regards the life-history of human malaria parasites, the occurrence of such a cycle in tissue cells instead of in red blood corpuscles was postulated by several investigators some years ago in an endeavour to explain why quinine is ineffective in preventing attacks of malaria due to the bites of mosquitoes and in preventing the relapses or recurrences which are such a troublesome feature of the human disease. In this connexion, we have repeated on chickens infected with *P. gallinaceum* some of the prophylactic and curative clinical trials with quinine and the synthetic antimalarial drugs which were made on other avian and on human plasmodia in 1931 and later years, and the results seem to indicate that the discovery of the endothelial cell cycle of the parasite opens up an entirely new field for chemotherapeutic research and may help to explain some of the clinical, therapeutic and epidemiological problems of malaria which hitherto have remained unsolved. We think this conclusion is justifiable despite the fact that as yet the discovery has been made only on bird malaria.

Fig. 1.

At a laboratory meeting of the Royal Society of Tropical Medicine and Hygiene which was held at the Royal Army Medical College on March 18, we showed a series of preparations of various stages of the cycle, including examples from birds which had been temporarily cured of the peripheral blood infection by quinine, but had died later as a result of the uninterrupted development of large schizonts in the endothelial cells lining the capillaries of the brain (Fig. 1).

We should like to add that the discovery, apart from its probable bearing on clinical and therapeutic problems, raises a question of interest to systematists in that it does not seem correct any longer to define the Plasmodiidæ as a family in which the whole of the vertebrate cycle of development occurs in the red blood corpuscles. *P. gallinaceum* is evidently a parasite which, in the vertebrate host, has a cycle of development similar to that of other members of the family Plasmodiidæ but, in addition, it has a cycle of development resembling, in some respects, the schizogonic cycle in endothelial cells which is ordinarily described as being characteristic of members of the family Hæmoproteidæ.

S. P. JAMES.
P. TATE.

Molteno Institute,
University of Cambridge.

[1] Brumpt, E., *C.R. Acad. Sci.*, **200**, 783 (1935).
[2] Brumpt, E., *Ann. Parasit. Hum. et Comp.*, **14**, 597–620 (1936).
[3] Huff, Clay, G., and Bloom, William, *J. Inf. Dis.*, **57**, 315–336 (1935).
[4] Raffaele, G., *Riv. di Malariol.*, **15**, 309–317 and 318–324 (1936).

Observation of Ultracentrifugal Sedimentation by the Toepler *Schlieren* Method

FOR the observations of concentration distribution in an ultracentrifuge cell during the process of sedimentation, methods depending on light absorption or refractive index have been used[1,2]. According to the latter procedure, as used in the sedimentation velocity measurements, a scale is photographed through the cell; from the measurements of the displacement of the scale divisions in the distorted image on the photographic plate, the concentration gradient in different parts of the cell is calculated. The resulting gradient diagrams show the number of components present, and their sedimentation velocities and concentrations can be accurately calculated.

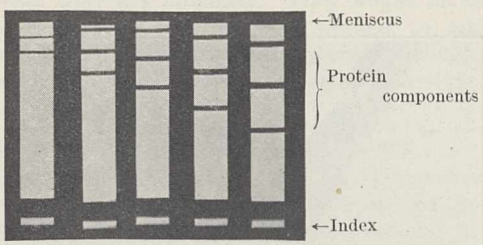


Fig. 1.

SEDIMENTATION PICTURES OF HÆMOCYANIN FROM *Limulus polyphemus* at *p*H 6·8. 5 MIN. BETWEEN EXPOSURES. CENTRIFUGAL FIELD: 120,000 TIMES GRAVITY. CELL THICKNESS: 12 MM. THE BLACK BANDS REPRESENT THE THREE COMPONENTS SEDIMENTING MOST RAPIDLY.

The well-known Toepler *Schlieren* method, also depending upon the deviation of a beam of light in a concentration gradient, has been used for many similar purposes[3]. Recently, one of us (A. T.) applied this procedure to electrophoresis measurements with quite satisfactory results[4]. The method has now been tried in observations of sedimentation velocities; some examples are given in Figs. 1 and 2. The following optical arrangement is used (Fig. 3): A lens placed as closely as possible behind the centrifuge cell projects an image of a horizontal slit through the cell on to the camera objective. In front of this is a vertically movable screen, having a horizontal edge with which any part of a deviated image of the slit may be cut off. When the screen is properly arranged, any gradients occurring in the cell will give rise to corresponding black bands visible to the eye in the image of the cell and recorded on the plate in the camera, as shown in Figs. 1 and 2. A tungsten ribbon lamp with a condenser lens is used for illumination of the slit.

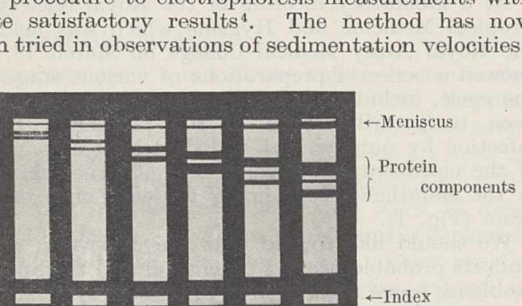


Fig. 2.

SEDIMENTATION PICTURE OF A PATHOLOGICAL SERUM (8 PARTS OF SERUM DILUTED WITH 3 PARTS OF A CONCENTRATED PHOSPHATE BUFFER). *p*H 6·8. TOTAL SALT CONCENTRATION: 0·25 MOLAR. 10 min. BETWEEN EXPOSURES. CENTRIFUGAL FIELD: 350,000 TIMES GRAVITY. CELL THICKNESS: 3 MM. BESIDES THE THREE COMPONENTS SEEN IN THE FIGURE, A FOURTH SLOW SEDIMENTING ONE APPEARED AT THE MENISCUS IN LATER EXPOSURES. (NORMAL SERUM UNDER THE SAME CONDITIONS SHOWS ONLY TWO COMPONENTS.)

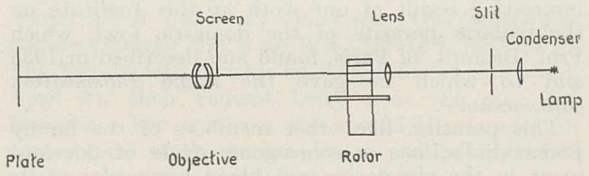


Fig. 3.

The method offers the advantage of rapid and convenient observation of components in mixtures and their sedimentation velocities. It also gives a rough idea of the relative amounts of the differently sedimenting substances. It may be modified also to give a more accurate determination of concentration[5], but for this purpose it does not seem to offer any advantage over the very accurate scale method previously mentioned.

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[1] Svedberg, The, *Z. physik. Chem.*, **121**, 65 (1926).

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[3] See for example: F. Kohlrausch, "Lehrbuch der praktischen Physik", and reference 5 below.

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Liquid Crystalline Preparations of Cucumber Viruses 3 and 4

IN a previous note[1], we showed that liquid crystalline substances infective at high dilutions could be isolated from solanaceous plants infected with three different strains of tobacco mosaic virus. We have been unable to transmit these strains to cucumber plants, and other workers have found cucumber to be immune to tobacco mosaic virus. From cucumber plants infected with cucumber viruses 3 and 4[2], we have now isolated nucleoproteins with a similar chemical composition and similar in many of their properties to those obtained from solanaceous plants infected with tobacco mosaic virus; they are, however, rather less stable and more difficult to isolate.

Of the methods of isolation yet tried, the following has proved most effective: expressed infective cucumber sap is coagulated by heating to 70° C., centrifuged and the supernatant fluid one quarter saturated with ammonium sulphate. A precipitate

consisting of small needles or fibres and giving a satin-like sheen is produced, and this is centrifuged off. The precipitate is now dissolved in water and reprecipitated several times with dilute ammonium sulphate solution and with acid at about *p*H 4·8. If this fails to give colourless solutions, further purification can be effected by high-speed centrifugation or by incubation with trypsin. Highly purified preparations of the cucumber viruses, if sufficiently concentrated, separate into two liquid layers; the lower layer is spontaneously birefringent and the upper layer readily shows the phenomenon of anisotropy of flow.

Systemic infections of cucumber plants were obtained by inoculating 1 c.c. of a solution containing 10^{-9} gm. of these nucleoproteins, and specific precipitates with antiserum were obtained with $1/8 \times 10^{-6}$ gm. No infection of tobacco, tomato, *Nicotiana glutinosa* or Golden Cluster beans (all of which are susceptible to tobacco mosaic virus) was obtained, even when they were inoculated with concentrated solutions.

Purified preparations of cucumber viruses 3 and 4 do not differ appreciably from one another in any of the properties yet investigated, but they differ in some respects from those of tobacco mosaic virus. Their precipitation point with acid in dilute salt solutions is about *p*H 4·8, and in the absence of salts about *p*H 5·5, whereas for tobacco mosaic virus preparations these points are *p*H 3·4 and 4·2 respectively. It is tempting to associate the difference in host range of the two groups of viruses with their behaviour with acid, for the *p*H of expressed cucumber sap is about 7·8 whereas that of tobacco sap is about 5·8.

The preparations of cucumber viruses 3 and 4 are very similar to one another antigenically, and they are also serologically related to those of tobacco mosaic virus. They differ antigenically, however, much more from tobacco mosaic virus than from one another, and much more than the recognized strains of tobacco mosaic virus differ from each other. As yet only preparations of viruses serologically related to tobacco mosaic virus have been found to show anisotropy of flow and to form spontaneously birefringent solutions. From plants infected with five distinct viruses not serologically related to tobacco mosaic virus, we have been unable to isolate any substances with these properties by precipitation with acid or strong salt solutions, although highly infective preparations have been obtained.

With these cucumber viruses, as with those previously described, we have been unable to dissociate virus activity from the liquid crystalline nucleoproteins, but there is no proof that our preparations contain only particles capable of infecting susceptible plants.

We wish to thank Dr. G. C. Ainsworth for supplying us with cucumber viruses 3 and 4, and Mr. E. T. C. Spooner for preparing the antisera used.

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[1] Bawden, F. C., Pirie, N. W., Bernal, J. D., and Fankuchen, I., NATURE, **138**, 1051 (1936).
[2] Ainsworth, G. C., *Ann. Appl. Biol.*, **22**, 55 (1935).

Latent Impurities in Electrodes used for Spectrographic Research

THE recent communication in NATURE by D. A. Webb[1] is of particular interest to me because for the last six years a minor part of my time has been devoted to an attempt to evolve a satisfactory spectrographic method for analysing plant material for the twenty or so elements usually present. Great progress has recently been made as a result of invaluable and much appreciated help given voluntarily by Mr. A. L. Tackley from September to January. The resulting method promises to be satisfactory and it is hoped to standardize it shortly. The great importance of the determination of the minor, as well as the major, elements in plant and animal tissues, in view of the increasing realization of their importance to the organism, seems to justify some mention of the progress made in meeting the difficulties mentioned by Webb.

The method consists in preparing small electrodes from the plant material itself without the addition of any foreign substance, except platinum wire, and comparing its spectrogram with that given by one of known composition prepared by adding pure substances to the purest grade of filter paper.

The plant material is kept at 200° C. for 24 hours, after which it is ground in an agate mortar. 0·0035 gm. of the dark brown powder is compressed in a specially constructed press under a pressure of the order of 500 tons per sq. in. around the end of a short length of platinum wire of diameter 0·005 in. The electrode is transferred by its platinum wire to a small specially designed electric furnace, in which the carbonization is effected by heating for five minutes at a low red heat, following a preliminary heating for the same length of time with half the current flowing. Two such electrodes, each measuring about 2 mm. in diameter and 1 mm. long, are held by the platinum wire and sparked in an atmosphere of nitrogen. Practically the whole of the material may, if desired, be disintegrated. It is fortunate that, under the conditions of excitation so far employed, the platinum spectrum has not appeared on the plate.

As is well known, even the purest filter paper contains minute quantities of impurities, mainly calcium and silicon. This admittedly is a drawback, but it is not a serious one, because these elements occur in comparatively large amount in almost all parts of plants. Filter paper has the great advantage for the purpose of being composed of one of the main organic constituents of the plant, namely, cellulose, so that the resulting electrode should resemble closely in texture the one prepared from plant material. Further, by means of specially designed micropipettes, known volumes of standard solutions may be quickly and accurately added to the paper. The pipette is filled by capillarity when its tip touches the surface of the liquid and is emptied by being allowed to touch the filter paper. The pieces of filter paper with their charges of salts are dried and treated in the same way as plant material.

The method, with slight modifications, should be applicable to a variety of types of material. In view of the promising results so far obtained, it will be developed as rapidly as limited man-power allows.

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[1] Webb, D. A., NATURE, **139**, 248 (1937).

Reaction of Nitric Oxide with Hæmoglobin and Methæmoglobin

THAT hæmoglobin reacts with nitric oxide is well known, but there is no agreement in the literature as to the mechanism of this reaction or the nature of the compound thus obtained.

According to Haurowitz[1], nitric oxide combines only with reduced hæmoglobin in complete absence of oxygen or even in the presence of a reducer (sodium hyposulphite, $Na_2S_2O_4$). Methæmoglobin, according to this author, does not combine directly with nitric oxide, but is reduced by it to hæmoglobin which then combines with more nitric oxide. Anson and Mirsky[2], on the other hand, consider that nitric oxide combines normally with methæmoglobin. They believe that hæmoglobin in presence of nitric oxide is oxidized to methæmoglobin, which then forms the nitric oxide compound. However, their experiments, consisting in injection of hæmoglobin by means of a syringe into a tonometer containing a mixture of nitrogen and nitric oxide, do not exclude the possibility of introducing dissolved oxygen, the latter giving rise to nitrogen dioxide, which may be responsible for oxidation of hæmoglobin to methæmoglobin.

Careful study of these reactions has convinced us that both these interpretations are only partly correct. All our experiments have been carried out in modified Thunberg tubes which received 3 c.c. of 0·5 per cent solution of hæmoglobin or methæmoglobin at *p*H 6·5, unless otherwise stated. The tubes were evacuated, washed several times with pure nitrogen, and filled with pure nitric oxide. According to the experiment, the hollow stoppers of the tube may receive various reagents which can be mixed with the contents of the tubes.

I. *Reaction between Nitric Oxide and Hœmoglobin.*

(1) Solutions of oxyhæmoglobin reduced in Thunberg tubes to hæmoglobin by evacuation, when mixed with nitric oxide, turn distinctly red and show two wide and somewhat diffuse bands at 574·5 mμ and 536 mμ.

(2) The same result is obtained in presence of an excess of sodium hyposulphite added at different stages of the reaction.

(3) This compound is very stable and is not decomposed by the addition of a great excess of sodium sulphite or by washing on an ultrafilter membrane.

(4) Potassium ferricyanide added to this compound after removal of excess of nitric oxide only slowly oxidizes it to acid methæmoglobin.

All this confirms Haurowitz's view that the reduced hæmoglobin combines with nitric oxide forming NO–Hb compound.

II. *Reaction between Nitric Oxide and Methœmoglobin.*

(1) An acid solution of methæmoglobin completely free from oxygen mixed in a Thunberg tube with pure nitric oxide rapidly turns red and its absorption spectrum is replaced by two bands at 568 mμ and 531 mμ. These bands are, however, more distinct than those of NO-hæmoglobin and lie 50–60 A. nearer the blue end of the spectrum.

(2) This compound is obtained in the presence of a great excess of potassium ferricyanide.

(3) A solution of acid methæmoglobin, before it is treated as in experiment 1, is mixed with 10 mgm. of sodium sulphite. When this solution is shaken with pure nitric oxide, the bands of methæmoglobin are rapidly replaced by the two bands at 568 and 531 mμ. On standing a minute or two, the colour and the absorption spectrum revert to those of acid methæmoglobin. This reversion can be repeated several times. Sulphite, on combining with dissolved nitric oxide, liberates acid methæmoglobin.

(4) A Thunberg tube with acid methæmoglobin and a little potassium cyanide in the hollow stopper is treated as in experiment 1. When the red compound with two absorption bands is formed, the cyanide is mixed with the solution and the absorption spectrum of NO-methæmoglobin is replaced by that of KCN-methæmoglobin.

(5) A similar experiment carried out with sodium fluoride instead of potassium cyanide gives only a partial formation of fluoride methæmoglobin. The incomplete reaction in this case is due to the comparatively low affinity of fluoride for methæmoglobin.

(6) If methæmoglobin is treated with nitric oxide at *p*H 5·6 and the tube is evacuated immediately the compound is formed, the NO-compound is almost completely reversed to methæmoglobin.

All these experiments clearly demonstrate that methæmoglobin forms with nitric oxide an easily reversible NO-MHb compound. This compound is, however, very unstable. Its absorption bands gradually become diffuse and move towards the red end of the spectrum. The NO-MHb, soon after its formation, is gradually transformed into a compound which is indistinguishable from NO-Hb, and this change is accelerated if the nitric oxide in the tube is replaced by nitrogen. The fact that this transformation is greatly accelerated on addition of a reducer (sodium hyposulphite) shows that NO-MHb in complete absence of oxygen undergoes reduction to NO-Hb.

Nitric oxide combines therefore with hæmoglobin (NO-Hb) and methæmoglobin (NO-MHb). With hæmoglobin it forms a very stable compound from which free hæmoglobin cannot be easily recovered. With methæmoglobin, however, it forms an easily reversible compound which is not stable and which, on standing, undergoes reduction to NO-Hb.

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[1] Haurowitz, F., *Z. physiol. Chem.*, **138**, 68 (1924); **151**, 130 (1926).
[2] Anson, M.L. and Mirsky, A.E., *J. Physiol.*, **60**, 100 (1925).

Aldehyde Mutase

IT is generally believed that aldehyde mutase (the enzyme which catalyses the dismutation of aldehydes in accordance with reaction (1)) is identical with aldehyde oxidase, which oxidizes aldehydes in accordance with reaction (2):

(1) $R\text{–}CHO + R\text{–}CHO + H_2O = R\text{–}COOH + R\text{–}CH_2OH$
(2) $R\text{–}CHO + A \quad + H_2O = R\text{–}COOH + AH_2$

where A may be O_2, methylene blue or some other 'hydrogen acceptor'. Wieland[1] suggests that the oxidase normally uses a hydrogen acceptor to produce an oxidation of the aldehyde, but when no other acceptor is present it uses a second molecule of aldehyde as acceptor, reducing it to alcohol and so producing a dismutation of aldehyde (reaction 1).

We find, however, that aldehyde mutase and aldehyde oxidase are two distinct enzymes which can be obtained separately. Oxidase preparations made from milk by the methods of Dixon and Thurlow[2] or Dixon and Kodama[3] are very active in catalysing the oxidation of aldehydes by oxygen or by methylene blue, but we can detect no trace of dismutation of

aldehydes by these preparations, even in presence of co-zymase. On the other hand, we have obtained very active mutase preparations by precipitating an aqueous extract of horse liver with alcohol, rejecting the precipitate, and again precipitating the fluid with a mixture of acetone and ether. These mutase preparations are totally unable to oxidize aldehydes either with methylene blue or with oxygen, even after addition of the cytochrome-oxidase system. (Some preparations made by Reichel's[4] method behave similarly, but others contain small amounts of aldehyde oxidase and catalyse both reactions.)

Not only can the two enzymes be prepared free from one another, but also they behave differently in several respects. The mutase is strongly inhibited by iodoacetic acid, which has little or no action on the aldehyde oxidase. The oxidase is completely inactivated by treatment with cyanide, which does not inhibit the mutase. On the whole, the oxidase acts better with aromatic, and the mutase with aliphatic, aldehydes, probably owing to differences of affinity. The mutase is apparently only active in the presence of co-zymase, in agreement with the views of Euler[5], whereas co-zymase is quite unnecessary for the oxidase. (Mutase from dog liver is practically inactive unless co-zymase is added; horse liver preparations appear to contain some co-zymase and are already active, but the activity is greatly increased by adding further co-zymase.)

The mutase preparations produce a rapid dismutation of methyl glyoxal, apparently to pyruvic acid and acetol, about 1 mol of acid being produced from 2 mols of the aldehyde in accordance with equation 1. Boiled mutase preparations of course have no effect. The milk oxidase preparations produce an apparent dismutation of methyl glyoxal, but roughly 2 mols of acid are produced from 2 mols of aldehyde; the product is lactic acid, and the reaction is given equally well by boiled oxidase preparations. This reaction is therefore not enzymatic, but is due to the milk proteins. The same reaction is brought about by glyoxalase, but whereas glyoxalase is inactive without its co-enzyme, glutathione, this system is independent of glutathione.

Most of the mutase experiments were done manometrically by measurement of acid production by the method used by Lohmann[6] and others. The reactions took place in dilute bicarbonate solution in Barcroft manometers, the flasks being filled with a mixture of 95 per cent nitrogen plus 5 per cent carbon dioxide (completely freed from traces of oxygen) before mixing the reactants. The acid then produced was neutralized by the bicarbonate, releasing an equivalent amount of carbon dioxide, which was measured manometrically. Corrections were applied for the 'retention' of carbon dioxide. Serious difficulties were encountered in following the mutase reaction by chemical estimations, but the main points were checked chemically.

The subject is being fully investigated, and the results will be published in detail elsewhere.

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[2] Dixon, M., and Thurlow, S., *Biochem. J.*, **18**, 971 (1924).
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[5] Euler, H. v., and Brunius, E., *Z. physiol. Chem.*, **175**, 52 (1928).
[6] Lohmann, K., *Biochem. Z.*, **254**, 332 (1932).

A New Biological Stain for General Purposes

IT was accidentally discovered while dissecting small Crustacea under spirit on a background of black velvet, that a dye dissolved very slightly in spirit and stained the chitin a distinct green. This observation was communicated to the Dyestuffs Group of Imperial Chemical Industries, Ltd., who succeeded, after investigation, in supplying a suitable dye in the Chlorazol series, which on further experiment was found to act as a very useful general biological stain.

This Chlorazol Black E *Biological quality* stains nuclei and chromosomes black, rivalling iron hæmatoxylin in its effects. At the same time, it stains cytoplasm and secreted products varying shades of grey. It can be used for whole tissues as well as for sections. It is an excellent stain for chitin which it stains green, and probably for glycogen which stains pink or red.

Its main advantages are that it requires *no mordant* and *no differentiation*, but if by chance sections or tissues are overstained, they can be differentiated in terpineol or dilute 'Milton'. It can be used in either alcoholic or aqueous solutions, and as it is only slightly soluble a small amount of dry stain is all that is necessary. A saturated solution in 70 per cent spirit stains ordinary sections in from fifteen to thirty minutes. So far as I have been able to test it, slides do not fade even if left exposed to daylight for twelve months.

A supply of this colour has been reserved by Imperial Chemical Industries, Ltd., and I have tested it and found it to be satisfactory. It can be obtained from any of the sales offices of Imperial Chemical Industries, Ltd.

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A Whale Shark rammed by a Steamer off Colombo, Ceylon

EARLY on the morning of November 23, 1932, the Dutch steamer *Johan van Oldebarnevelt*, Captain Julsing commanding, caught a whale shark on her bow in lat. 7° 5′ N., long. 77° 50′ E.—about 150 miles west of Colombo, Ceylon. The shark (size not noted) was killed, and when the vessel was slowed down it sank. Captain Julsing knows the whale shark and states that this fish in size, shape and colour markings was a counterpart of the other which his vessel killed in 1933—presently to be noted. This phenomenon seems worthy of brief record for a number of reasons. It is an extraordinary thing in itself. Also, it is the second time that this vessel has impaled a whale shark on her bow, and it makes the fifth record of such an extraordinary happening. Finally, it adds another *Rhineodon typus* to the roster of this fish recorded for Ceylonese waters.

In November 1933, the *Oldebarnevelt* struck and killed a whale shark off the Island of Perim, in the Strait of Bab el Mandeb. Fortunately for science, the Dutch ichthyologist, Dr. H. C. Delsman, was on board. He saw the fish hung on the stem of the vessel, positively identified it, and recorded the occurrence in NATURE[1].

However, this is neither the only nor the first whale shark rammed by a vessel in the Red Sea. On May 14, 1933, the Italian steamship *Francesco Crispi*, while off Port Sudan, on the west side of the Red Sea about half-way down from Suez, was slowed down

by a great spotted shark bent double over the prow of the vessel. The whole matter was investigated and reported on fully with much photographic evidence by Renato Santucci[2].

Still earlier, I had recorded two similar happenings[3]. On July 6, 1924, the Elder Dempster and Co.'s motor vessel *Alba*, in the Gulf of Guinea (lat. 4° 28′ N., long. 6° 24′ W.), ran into a whale shark—breaking its back. Earliest of all, the Munson liner *American Legion* ran afoul of a 30-ft. specimen in lat. 17° 57′ S., long. 38° 41′ W.—near the Abrolhos Light, off the coast of Brazil.

Finally, it is of interest to note that the whale shark rammed by the *Oldebarnevelt* off Colombo, in 1932, makes a fourth definite record of this fish for Ceylonese waters. The whole question of *Rhineodon* in this region has been carefully gone into in a communication published by me in 1933[4]. In this a number of reputed occurrences were shown to be erroneous. In addition to the four whale sharks definitely to be assigned to Ceylon, three have been recorded from the neighbouring waters of southern India—one at Trivandrum and two at Madras. The total count for southern India is, then, at present, seven specimens.

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[1] NATURE, **133**, 176 (1934).
[2] *Boll. Mus. Lab. Zool. Anat. Comp. Univ. Genova*, **14**, No. 14, 14, 7 figs. (1934).
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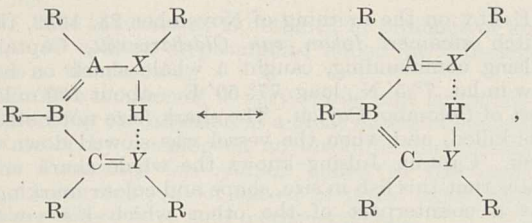
Synchronized Oscillations in Hydrogen Bridges

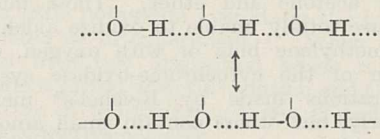
MOST of the compounds now known to contain intramolecular hydrogen bridges can be represented[1] by the formulæ:



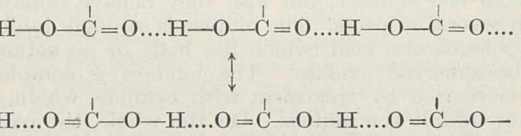
in which X and Y denote oxygen or nitrogen atoms. As indicated, there is undoubtedly resonance between the two extreme structures represented. An equally important but apparently hitherto overlooked stabilizing factor is the tendency of the electron distribution around the ring to shift in synchronism with the oscillational motion of the bridge hydrogen. The electron shifts produced by motion of this hydrogen in the direction X—Y decrease the X—H attraction and increase the Y—H attraction. As a result, the small energy hump which would probably otherwise exist[2] in the centre of the bridge is greatly reduced or eliminated entirely, and the bridge stability is increased.

In rings containing two hydrogen bridges, such as occur in the formic acid dimer[3], in β oxalic acid[4] and in isatin[5], the two bridging hydrogens tend to oscillate synchronously, the oscillation of each aiding that of the other.

Synchronous oscillation of the hydrogens of hydrogen bridges suitably linked together in long strings must increase their stability. In resorcinol[6] and in a number of inorganic hydroxides, resonating bridge systems of the type



apparently exist. In α oxalic acid[4], the resonating system is



In proteins, the chief forces (other than those in the crystine and similar cross links) connecting the primary chains I believe to be due to hydrogen bridges. Both the so-called 'salt linkages' and the frequently assumed attractions between CO and NH groups may reasonably be assumed to be of this character. A reasonable structure for β keratin[1,7], for example, is one involving synchronized hydrogen and electron oscillations along..HNCOHNCOHNCO..strings comparable to the..HOCOHOCOHOCO.. strings in oxalic acid. With other proteins (and with keratin in less extended form) structures differing in detail must be assumed, but in all, I firmly believe, NHO bridges are most important in joining the primary chains. Pictures of this sort seem to me preferable to those proposed by Wrinch[8].

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[2] Huggins, *J. Amer. Chem. Soc.*, **58**, 694 (1936); *J. Phys. Chem.*, **40**, 723 (1936).
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[5] Cox, Goodwin and Wagstaff, *Proc. Roy. Soc.*, A, **157**, 399 (1936).
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[7] *Cf.* Astbury, "Fundamentals of Fibre Structure" (Oxford Univ. Press, 1933); *J. Text. Inst.*, **27**, P282 (1936).
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Effect of Turbulence on the Propagation of Sound

IT is a well-known fact that the propagation of sound in the atmosphere is greatly affected by temperature and wind conditions, yet quantitative data on the actual field of intensity from a sound transmitter are scarce. During some recent studies of the acoustical effect of fog-horns, we determined the attenuation of the sound at the sea surface[1]. A condenser microphone was used at intensities greater than 40 decibels and an auditory comparison method was used at lower intensities. Intensity charts are reproduced herewith (Fig. 1) for two succeeding days on which there were weak winds and apparently homogeneous atmospheric conditions. The two charts show clearly the effect of differing wind direction, but other differences between them are also obvious. On December 13 (B, Fig. 1) the air probably was stratified either with respect to velocity or to temperature, since the intensity chart shows a marked minimum to the north-west.

Independently of these differences in the average field on the two days, our instruments showed rapid variations in the observed intensity. These were not discovered by the ear, the sensitivity of which to intensity differences is rather low for the frequency applied, 300 c./s. Within one sending period of the transmitter, namely, 3 seconds, the variations of energy at the place of observation were often 5–10 decibels (special measurements showed that these variations were not due to fluctuations of the transmitter). We must thus imagine that the surfaces of equal intensity were rapidly changing in a most irregular way, giving an average picture as represented above.

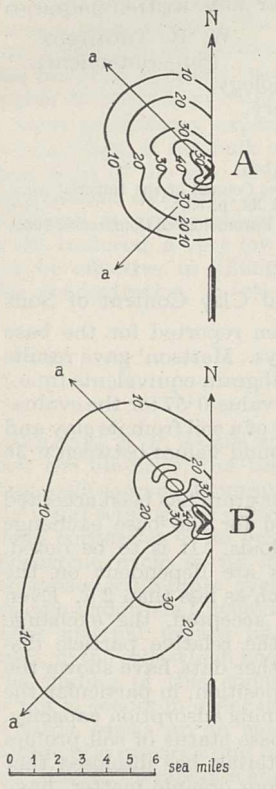

Fig. 1.

FIELD OF INTENSITY (IN PHONS) AT THE SEA SURFACE OF A DOUBLE SOUND TRANSMITTER. *a,a*, AXIS OF HORN. *A*. DECEMBER 12, 1935. WIND S.S.E.; BEAUFORT 2–3. *B*. DECEMBER 13, 1935. CALM OR WIND BETWEEN N.N.E. AND N.; BEAUFORT 1–2.

As already pointed out by Devik[1], the *turbulence* of the air is probably the cause of these great variations. We do not here refer to the molecular dispersion of sound (compare V. O. Knudsen[2]) but rather to the irregular distribution of rolling and whirling 'air bodies' of a great variety of sizes, which we assume will cause a dissipation of sound energy especially pronounced for those wave-lengths which are of the same order of size as the 'air bodies' themselves. If this be the case, the study of the attenuation of a sound spectrum in open air might furnish a method for studying the turbulence of the air. Experimental research in this direction is being prepared here.

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Feb. 1.

[1] Devik, Olaf, *Chr. Michelsens Inst. Beretninger*, **6**, 2 (1936).
[2] Knudsen, V. O., *J. Acous. Soc. Amer.*, **6**, 199–204 (1935).

Raman Effect as a Method of Analysis of Amino Acid Solutions

THE possibility of using the Raman effect for quantitative analysis depends upon two conditions: (1) The components of the mixture in question should possess distinguishable spectra, a requirement depending on the nature of the molecules. (2) The photographed spectra should be sufficiently intense and the background clear enough to provide good microphotometer measurements. The accompanying account concerns an investigation of these conditions in the case of amino acid solutions.

The experimental arrangement was similar to that used by Wood[1], employing a 600-watt, air-cooled, quartz mercury arc. Because the solutions of recrystallized amino acids often exhibited fluorescence (due to minute amounts of impurities) when exposed to the blue light of the arc (4358 A.), it appeared advisable in the present case to adopt the green line (Hg 5461 A.) for the Raman excitation. A further reduction of fluorescence was effected by treating the neutral solutions with a small amount of potassium iodide. Two filter solutions, one of dilute potassium dichromate and the other of saturated neodymium chloride, served respectively to remove the blue end of the mercury spectrum and to absorb the region from 5680 A. to 5910 A. The spectrograph was a two-prism instrument providing a dispersion of 64 A./mm. in the yellow; exposure times varied from ten to thirty hours.

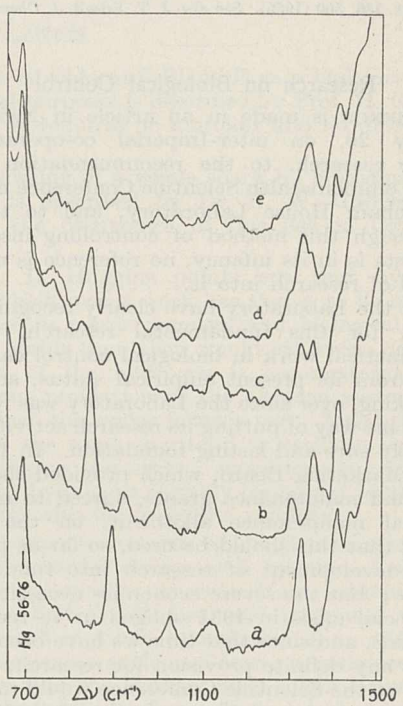

Fig. 1.

According to previous measurements by us on the Raman effect of several amino acids[2], the region corresponding to displacements of 700–1500 cm.$^{-1}$ (interval cleared of light from the arc by the neodymium chloride band in the present arrangement) was well adapted for the purpose at hand. Additional measurements of Raman frequencies made since the earlier publication are listed below: *dl*-Valine (aqueous solution, 5 per cent, 20 per cent potassium iodide): 760 cm.$^{-1}$ (6), 828 (6), 893 (4), 945 (8), 1063 (3), 1130 (4), 1196 (3), 1276 (2), 1326 (10), 1360 (9), 1410 (8). *l*-Leucine (aqueous, 1·55 per cent, 20 per cent potassium iodide): 840 (10), 964 (10), 1060 (2), 1135 (5), 1175 (2), 1351 (10), 1412 (2). *dl*-Phenylalanine (aqueous, 2 per cent, 20 per cent potassium iodide): 432 (1), 487 (1), 622 (3), 755 (1), 824 (2), 925 (1), 1003 (10), 1032 (4), 1211 (4*b*), 1270 (1), 1349 (2*b*).

Microphotometer records are shown in Fig. 1 of the Raman spectra of 5 per cent aqueous solutions of glycine (*a*), *dl*-alanine (*b*), *dl*-valine (*c*), and a

mixed solution of 5 per cent each of the three (*d*). The spectrum (*e*) is that of a zein hydrolysate from which the less soluble amino acids have been partially removed by crystallization. These curves reveal the situation as regards analysis very clearly. With no more than three of the simpler amino acids together in a solution, overlapping of the lines most suitable for measurement can be observed. As most protein hydrolysates are vastly more complicated than this simple case, it would seem undesirable to attack such solutions without further chemical separation. If cases should arise, however, where solutions under examination contain very few different amino acids, the Raman effect might indeed be of great value in analysis.

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[1] R. W. Wood, "Physical Optics" (3rd Edition 1934).
[2] NATURE, **136**, 300 (1935). See also J. T. Edsall, *J. Chem. Physics*, **4**, 1 (1936).

Research on Biological Control

REFERENCE is made in an article in NATURE of February 20, on inter-Imperial co-operation in scientific research, to the recommendation of the British Commonwealth Scientific Conference concerning Farnham House Laboratory, and to the fact that, though this method of controlling insect and plant pests is in its infancy, no reference is made to the need of research into it.

We at the Laboratory have clearly recognized the necessity for this fundamental research, without which practical work in biological control can never emerge from its present empirical status, and have been seeking, ever since the Laboratory was founded, to find some way of putting its research activities on a reasonably sure and lasting foundation. In 1929 the Empire Marketing Board, which provided the initial capital and maintenance grants, agreed to make an additional maintenance allotment, on the understanding that this should be used, so far as possible, for the development of research into fundamental problems ; but the severe economies necessitated by the financial crisis in 1931 obliged us to recast our programme, and since that time we have been unable to make any definite provision for research. It was hoped that the Scientific Conference would make the necessary recommendations, as the desirability of this was mentioned in the report of the Laboratory for 1935–36[1], and had been previously stressed by the Imperial Entomological Conference[2].

Since official support for research work has not been forthcoming, and the necessity for fundamental studies is increasing because of the rapid growth in the practical side of the work, the only possible course seems to be to appeal to individual workers interested in research on biological control, to avail themselves of the facilities offered by the Laboratory for investigations of this kind. The accommodation is limited ; but it will be gladly put at the disposal of students and others qualified for the work. The main lines of research requiring development concern parasite behaviour, population studies, from the biomathematical angle, particularly the interactions between host and parasite populations, and genetic studies, for which large masses of material collected under a considerable range of environmental conditions, are readily available. Abundant material for cognate studies in the development and morphology of insect parasites is continually coming in. There is thus an opportunity for the pursuit of many fascinating lines of investigation of great scientific and practical value.

I shall be glad to answer any written inquiries with regard to the work.

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[1] Seventh Annual Report, Executive Council of the Imperial Agricultural Bureaux, 1935–36, Appendix XI, p. 85.
[2] cf. Report of the Fourth Imperial Entomological Conference, 1935, Appendix Ia, par. 21.

Base Exchange Capacity and Clay Content of Soils

VARYING factors have been reported for the base exchange capacity of soil clays. Mattson[1] gave results ranging from 0·16 to 1·1 milligram equivalents (m.e.) per gram. Williams[2] uses the value 0·57 for the evaluation of the exchange capacity of a soil from its clay and carbon contents. Hissink[3] found values between 0·36 and 1·00 for Dutch soils.

In general, 0·5–1·0 m.e. per gram has been accepted as the range to be expected for the base exchange capacity of mineral soil colloids. It is to be noted, however, that these values are dependent on the definition of particle size, such as less than 2 μ. Even if this upper limit can be accepted, the exchange capacity must depend on the relative particle distribution. Mattson's[1] and other data have shown the importance of chemical composition, in particular the $SiO_2 : R_2O_3$ ratio, in determining adsorption capacity.

The investigation of the base status of soil profiles on basic igneous parent materials has disclosed that some lower horizons, free from organic matter, have a base exchange capacity of up to 9 m.e. per gram of (< 2 μ) clay. The accompanying table shows some of the results obtained :

Soil	SiO_2/Al_2O_3	Clay Content	Exchange Capacity	m.e. per gm. Clay
4792	1·55	16·0	35·2 (32·9)	2·2
5048	3·83	11·6	42·5 (43·0)	3·7
5044	4·05	10·7	41·8 (39·0)	3·9
4784	5·95	9·8	42·1 (38·9)	4·3
5001A	8·40	15·7	88·0 (98·6)	5·6
5002	2·16	3·8	34·8 (29·6)	9·1

The exchange capacity figures used were obtained by the Parker method[4]. Those in brackets are the sums of the individual exchangeable cations. The agreement between the two sets of figures demonstrates the truly exchangeable nature of the cations. Apart from the last sample, there is an approximately linear relationship between SiO_2/Al_2O_3 ratio and exchange capacity per gram (< 2 μ) clay.

Further work is at present in progress on these soils, and the results obtained will be reported elsewhere. We desire, however, to point out that soils with very high exchange powers relative to their clay contents exist, and to direct attention to the danger of indiscriminate application of clay exchange capacity factors to soils to which they do not apply.

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Macaulay Institute for Soil Research,
Craigiebuckler,
Aberdeen, Feb. 16.

[1] *Proc. 1st Inter. Cong. Soil Sci.*, 2, 199 (1927).
[2] *J. Agric. Sci.*, **22**, 845 (1932).
[3] *Trans. 3rd Inter. Cong. Soil Sci.*, 2, 60 (1935).
[4] *J. Amer. Soc. Agron.*, **21**, 1030 (1929).

Absorption of Fumigants under Reduced Pressure

THE importance of absorption of gases in reducing the effective concentration during fumigation of various materials for the destruction of insects, is now coming to be recognized, but the full effect of this factor in so-called 'vacuum fumigation' does not appear to have been realized.

Some preliminary experiments with a patent flour indicate that, if the bulk of the air be first removed, then most of the gas, which penetrates by virtue of the pressure difference established on admitting the fumigant, is rapidly absorbed, leaving, in the interior of the material, a very low concentration, which may not be effective in killing the insects. Afterwards the concentration in the middle of the material increases slightly owing to the diffusion, as in a fumigation at ordinary pressure. This is true whether the pressure is brought up to atmospheric by employing a fumigant diluted with an inert gas, or whether the pressure is raised only by the amount due to the pure or slightly diluted fumigant.

The result appears to be that the fumigation of absorbent materials under reduced pressure possesses little advantage over fumigation at normal pressure. This work is being continued and we hope to publish a detailed account in due course.

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Points from Foregoing Letters

COLONEL S. P. JAMES and Dr. P. Tate have found that the life-history of the malaria parasite *Plasmodium gallinaceum*, Brumpt, comprises, in addition to the usual schizogonic cycle of development in the red blood corpuscles of its vertebrate host and the usual sporogonic cycle in its insect host, a hitherto unrecognized vertebrate cycle occurring in cells of the reticulo-endothelial system of the spleen, liver and other internal organs and particularly, in certain cases, in the cells which line the capillaries of the brain. The finding of this endothelial cell cycle, whether or not it occurs in other malaria parasites than those of birds, opens up an entirely new field for chemotherapeutic research and may help to explain some of the clinical, therapeutic and epidemiological problems of malaria which hitherto have remained unsolved.

The usefulness of the Toepler *Schlieren* method for sedimentation observation in the ultra-centrifuge has been demonstrated by A. Tiselius, K. O. Pedersen and Inga-Britta Eriksson-Quensel. The method has the advantage of allowing direct observations, during the experiment, of the number of components in a mixture and their sedimentation velocities.

A method of obtaining liquid crystalline preparations of cucumber viruses is described by F. C. Bawden and N. W. Pirie. The authors compare some of the properties of these viruses (precipitation point in acid and salt solutions, etc.) with those of the tobacco mosaic viruses. The purified cucumber viruses can infect cucumber plants in dilutions of one part in a thousand million, and one eighth of a millionth of a gram will give a specific precipitate with antiserum.

A method of eliminating possible impurities in the electrodes used for spectrographic detection of plant constituents is described by W. A. Roach. It consists in preparing small electrodes from the plant material itself by suitable treatment and carbonization.

Reactions between nitric oxide and hæmoglobin, and also methæmoglobin, are described by Prof. D. Keilin and D. F. Hartree, indicating that a very stable compound is formed with hæmoglobin and an easily reversible one with methæmoglobin.

Drs. M. Dixon and C. Lutwak-Mann describe results showing that aldehyde mutase and aldehyde oxidase, hitherto believed to be identical, are in reality distinct enzymes. They can be prepared separately, and they show fundamental differences in behaviour.

The use of Chlorazol Black E as a biological stain for general purposes is described by Prof. H. Graham Cannon. It requires no mordant and no differentiation.

The ramming of a whale shark by a steamer near Colombo is described by Dr. E. W. Gudger, who discusses the occurrence of this fish in Ceylonese waters.

Dr. M. L. Huggins points out that hydrogen bridges, which recent work has shown to be of great importance in many chemical and biological fields, are more stable than they would otherwise be if the oscillation of the hydrogen is accompanied by a synchronous oscillation of the electron system in a ring of which the bridge forms a part. Two hydrogen bridges in the same ring tend to oscillate together, each stabilizing the other. Synchronous oscillation of bridging hydrogens suitably connected together in long strings also increases the stability.

Microphotometer records of the Raman spectra of solutions of several amino acids (glycine, *dl*-alanine, *dl*-valine) separately and mixed are submitted by N. Wright and W. C. Lee, and compared with a similar record of a zein hydrolysate, from which the less soluble amino acids had been partially removed. It appears that the Raman effect might be used for quantitative analysis of proteins in solutions containing very few different amino acids, but that it is not applicable to more complex mixtures.

Quantitative measurements by H. Dahl and Dr. Olaf Devik of the intensity of the sound field of fog-horns has shown rapid variations which were not observed by the ear. The cause of these rapid variations is considered to be the turbulence of the air. If this is the case, the study of the attenuation of a sound spectrum in the open air might furnish a method for studying the turbulence of the air.

Dr. R. L. Mitchell and Dr. Alex. Muir direct attention to the high base exchange capacity relative to the clay content of certain soils derived from basic igneous parent materials in Scotland.

A preliminary study of the concentration of gas inside certain materials fumigated by various methods employing reduced pressure shows, according to Drs. A. B. P. Page and O. F. Lubatti, that owing to absorption there is no resultant increase of penetration. It appears that, with these materials, a vacuum process has no advantage over one at normal pressure.

Research Items

Early Contacts of East and West

PROF. C. G. SELIGMAN in his Lloyd-Roberts Lecture for 1935, delivered before the Royal College of Physicians, on "The Roman Orient and the Far East" (*Antiquity*, March) dealt mainly with historic contacts extending over something more than a thousand years, from 200 B.C. to A.D. 900, touching in the prehistoric period only on the distribution of the socketed celt, one of the most characteristic implements of the Late Bronze Age in central and eastern Europe, which probably reached China five to six hundred years before Christ. Its presence may be associated with events in the far north-west which started the movements of the Scyths. It was borne eastward on a wide front across the Urals. In the historic period, the great silk route, five thousand miles long, joined the Far East with Antioch, the most important city of the Roman Orient. It was first organized in the second century B.C., though long before this lapiz lazuli had reached Ur and predynastic Egypt (that is, 3000 B.C. and earlier). The eastern section of the route may be regarded as starting at Ch'ang An (the Han capital), or at Langchow in western Kansu. It crosses Sinkiang to Kashgar, 1,500 miles away, Turfan lying half-way. The middle section crosses the Pamirs to Merv, either by Samarkand or Balkh. From Merv it runs west and south across north Iran to Seleucia-Ctesiphon, just below the modern Bagdad, crosses the Euphrates at Zeugma, and so thence to Antioch. The factors tending to the use of the silk route in the first instance were neither commercial, desire for knowledge nor love of conquest, but sheer military necessity—to counter the attacks of the barbarians. But there was also the desire for a supply of fine horses from Iran, while another gift from Ferghana was the grape for wine. From east to west the road essentially carried silk and secondarily furs. In addition to gold the Roman Orient exported glass. In the great period of the T'ang dynasty (A.D. 621–907) the silk route attained its maximum importance ; and while China shows the effect of the impact of western art and art forms, as well as of legend and story, it gave to the west paper and printing.

Mammals of Oregon

THE State of Oregon illustrates in general the history of any mammalian fauna under the rule of civilized man. The quest of valuable furs brought pioneers into the region, and the abundance of game is still an economic factor of some importance. As man and domestic animals increased, animals destructive to game, livestock, poultry and crops had to be destroyed or controlled, with the result that predatory animals are reported to be generally decreasing in abundance, while a few creatures such as wapiti and other deer, pronghorn antelopes and porcupines are said to be increasing in numbers. In his account of the "Mammals of Oregon" (*North American Fauna*, No. 55. U.S. Dept. Agr. Pp. 416), Vernon Bailey discusses with a large amount of detail the economic as well as the natural history and taxonomic aspects of a fauna which includes 246 species and races. Oregon shows great diversity of altitude and of climate, and the consequent zonal distribution of its vertebrates and its plants throughout five of the seven primary life zones of the American continent (tabulated on pp. 31–53) contains much that is of ecological interest. We note that the author does not fear any undue spread of the muskrat, for although he admits that it is capable of doing serious damage in irrigated areas, he holds that more thorough trapping and a long open season usually afford all the protection necessary.

Digestion in Metazoa

THE problem of the modes of digestion adopted by the Metazoa has been reviewed by Prof. C. M. Yonge (*Biol. Rev.*, Jan. 1937). In Protozoa and Porifera, digestion is obviously intracellular, and this method is retained to a certain extent in different groups of the Metazoa. Extracellular digestion is found to a greater or lesser extent in all of them. This method is obviously advantageous since it allows food to be digested and the non-utilizable material to be removed more quickly, thus permitting an increase in the rate of metabolism. It is also associated with a differentiation in certain regions of the gut and so produces more efficient mechanisms for dealing with the various processes involved in ingestion, digestion, absorption and the formation of fæces. Some groups have acquired enzymes which enable them to deal with special substances. In general, the food passes through the alimentary canal at such a rate as will enable it to be adequately digested, taking into consideration the temperature, *p*H and enzymes. Such specialization has enabled the successful groups to utilize a wider range of foodstuffs and to tap more varied sources of supply. A full bibliography is appended.

Sites for Anemographs

AN account of the peculiar performance of a Dines anemograph at the Lizard (Prof. Note No. 73, Meteorological Office, Air Ministry, by M. J. Thomas. London : H.M. Stationery Office, 1936) shows the care that is required when selecting a site for an anemograph in order to get a representative record of the speed and direction of the wind. It was observed that with most winds the record showed the gustiness and variability of wind direction to be expected in a reasonably open situation, with the vane of the anemograph at a height of 40 feet above the ground, but that when the general wind in the neighbourhood was between about south-south-west and west-south-west the vane fluctuated wildly, and sometimes 'boxed the compass' at short intervals for hours. Inquiry was made into the cause, and it was found that violent eddies were being set up by a row of coastguards' houses about 30 feet high and more than 100 feet away in the direction from which the general wind was blowing during the most disturbed periods. These eddies were studied with the aid of ballons of zero lift, both free and tethered, and bamboo poles with long streamers, and the nature of the eddies was brought to light. The pamphlet shows their movement both in plan and elevation. The trouble was eventually cured by raising the vane of

the anemograph to a height of 75 feet; that is, it was brought to a height of 45 feet above the houses instead of only 10 feet. After the change, normal gustiness and variation of direction was obtained, as is illustrated by the anemogram for several hours of a severe gale during which the average wind direction changed from south to nearly west.

Artificial Radioactivity Produced by Means of γ-Rays

ARTIFICIAL radioactivity has recently been produced in the elements copper, bromine and phosphorus by bombarding them with γ-rays obtained by the action of protons of energy greater than 450 kV. on lithium (W. Bothe and W. Gentner, *Naturwiss.*, **25**, 90; 1937). Observations of the half-life periods of the radioactive nuclei enables them to be identified. Copper gives a radioactive nucleus of half-life about 11 min. Heyn (NATURE, **138**, 723; 1936) obtained by another method, a half-life of 10·5 min. for the ^{62}Cu nucleus. It therefore seems likely that this is the nucleus formed in the present transmutation, and that the process involves loss of a neutron from ^{63}Cu. In the case of bromine, the radioactive nucleus had a half-life period of about 18 min., which is the same as that of ^{80}Br obtained by the action of slow neutrons on ^{79}Br. Phosphorus gives a radioactive nucleus of weak activity with a half-life period of 2–3 min. This is probably to be identified with ^{30}P, which has been obtained by other methods indicating for it a half-life of 3·2 min. As with copper, the radioactive nuclei obtained from bromine and phosphorus are produced by the loss of a neutron from the normal nuclei.

Long Wave Spectroscopy of Benzene

SPECTROSCOPIC investigation of C_6H_6 and C_6D_6 by Angus, Bailey, Ingold, *et alia* (*J. Chem. Soc.*, 912; 1936) pointed with considerable certainty to a molecular symmetry of D_{6h}, and this has recently been substantiated by the thermal-spectroscopic determination of the symmetry number by Lord and Andrews (*J. Chem. Phys.*, **41**, 149; 1937). But definite conclusions must await further experimental evidence on (*a*) the spectra of partly-deuterated benzenes of lower symmetry, and (*b*) the influence of temperature and change of physical state on the characteristics of the spectrum. Evidence on both these lines is forthcoming. Redlich has already published some interesting measurements on partly deuterated benzenes. Along the other line, the results of Sirkar (NATURE, **134**, 850; 1934; *Indian J. Phys.*, **10**, 189; 1936) are particularly interesting. From an examination of the Raman spectrum of C_6H_6 vapour at 210° C. and 16·6 atmospheres, he has shown that the intensity distribution of the rotational wings accompanying Rayleigh lines agrees with that predicted from the theory of rotational Raman scattering. In the later paper, he has given results for the temperature range from liquid air temperature to 210° C. and for solid, liquid and gaseous C_6H_6. At low temperatures he found a slight diminution in the numerical values of frequency displacements and an increased sharpness and intensity, in agreement with the earlier observations of Epstein and Steiner (NATURE, **133**, 910; 1934). By comparing the spectra of liquid and gaseous C_6H_6 at 210° C., he has shown that the numerical values of displacements are unchanged, but transition from liquid to vapour is accompanied by greatly diminished intensity. A similar comparison by Bhagavantam and Rao (NATURE, **139**, 114; 1937) leads to the same result. Knowledge of these variations will help to elucidate the part played by intermolecular forces, and will assist in explaining the apparent breakdown of selection rules when applied to experimental data.

Diamantine Compounds

IN the February issue of the *Berichte der deutschen chemischen Gesellschaft*, Dr. Oskar Böttger describes the synthesis of several complex cyclic compounds in which carbon atoms are linked together rigidly but without strain in the manner of the crystal lattice of the diamond. The parent hydrocarbon of such a series is still unknown, but as several of its derivatives have now been synthesized it is proposed to call it *diamantane*. Its highly symmetrical structure would result from the condensation into a three-dimensional network of four puckered cyclohexane rings of the *Z* variety, and its formula would be $C_{10}H_{16}$. By the action of methylene dibromide on the disodium derivative of bicyclo [1 : 3 : 3] nonane 2·6·dione 1·3·5·7 tetramethylcarboxylate, it was possible to synthesize a compound which possesses the same skeletal structure as diamantane and crystallizes in fine colourless octahedra, melting at 284° C. Hydrolysis of this ester to the corresponding tetrabasic acid was readily effected by dilute acids, whereas alkaline hydrolysis broke down one of the rings to yield a pentacarboxylic acid derivative of bicyclononanone, which could be extracted in the form of its methyl ester. The freedom from ring-strain of the polycyclic system can be inferred from the ease with which this pentamethyl ester reverts to the diamantine structure by eliminating methanol, when it is heated above 200° C. On the other hand, this structure appears to influence the chemical properties of its substituent groups, since the acid groups did not yield to the usual methods of decarboxylation, nor was it possible to reduce the two keto-groups to methylene groups, for even hydrogen iodide and phosphorus under pressure yielded only secondary alcohols. The optical isomerism of the products has not yet been investigated.

Scope and Development of Indian Astronomy

IN an article in *Osiris* of September 1936, Sukumar Ranjan Das says that Indian astronomy had its beginning in the Vedas, and was then very rudimentary. This is incorrect; the ancestors of the Vedic authors brought their astronomy with them when they came to India, and these astronomical conditions are both extensive and well founded, and were quoted throughout the much later Rg Veda and the liturgical Vedas and Brahmanas. The author has happily cut himself free, however, from the current idea that Indian astronomy was ever dependent on the Grecian or Ptolemaic systems; indeed India gave more than it ever got, except perhaps as regards planetary observations. Ranjan Das suggests that the Rg Veda has three allusions to the planets, but the contexts forbid this interpretation. The most interesting section is on the Samhitās and older Siddhāntas (dating between 500 B.C. and 500 A.D.). He gives a tantalizing reference to an observation in 215 B.C. of "the Sun and Moon in conjunction at sunrise *on a Sunday*" at the winter solstice, or the beginning of the solar month Māgha. Was time at that date divided into 7-day weeks for purposes of chronology, similar to our division of the Julian days? It certainly was so divided in the days of Āryabhata I, in the fifth century A.D.

The South-East Essex Technical College

THE construction of new arterial roads together with the development of estates like those of Becontree and Dagenham have resulted, within the last ten years, in a considerable increase in the population of Essex. The establishment, too, of large industrial centres, such as Ford's Motor Works at Dagenham, have also contributed materially to this almost mushroom growth. Acres of pasture land have thus been transformed into industrial and densely populated districts. It therefore became an urgent necessity to make some provision for extended educational facilities, and especially for further technical education.

in Great Britain. Along the Longbridge Road, about two miles from Barking Station and close to the south-eastern boundary of the Borough of Ilford, a stretch of land, about 17 acres in extent, was secured and upon approximately 6 acres the college building was erected (Fig. 1). Although the premises are really not yet complete, accommodation is to be provided for about 5,000 evening students and 1,000 full-time day scholars from eleven to sixteen years of age and 750 senior students. To meet the needs of the essential recreative facilities for so large a number, the Committee is trying to secure more land in order to extend the acreage to about 30. It also proposes, in

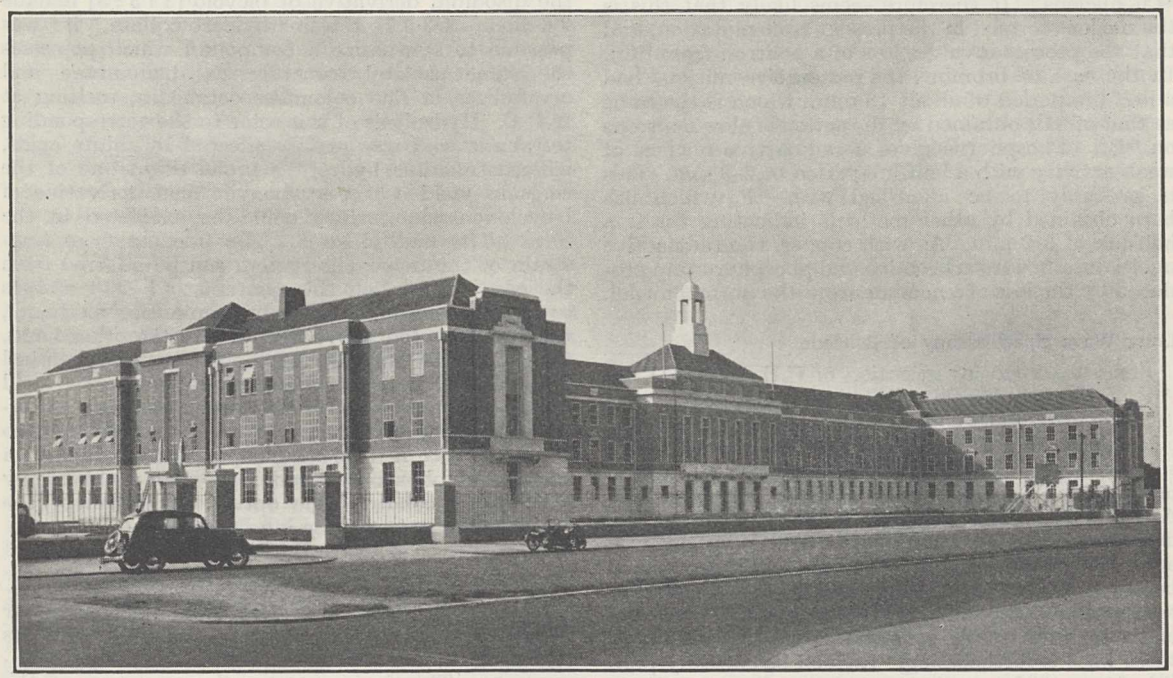

Photo *C. Marshall Smith*

Fig. 1. THE SOUTH-EAST ESSEX TECHNICAL COLLEGE.

After an exhaustive survey of the problem, the Essex Education Committee wisely decided that a regional system of organization for higher education generally would be, at present, the best solution. To carry this policy into practical effect, each region is to be provided with a central institution "to act as a focus of the more advanced forms of technical, art and commercial instruction". The first of these institutions—known as the South-East Essex Technical College—was officially opened by the Right Hon. Oliver Stanley, president of the Board of Education, on Tuesday, November 24, 1936, although some four thousand students had already started courses of instruction on September 28, 1936.

Through the courtesy of the Director of Education (Mr. J. Sargent) and the Principal (Mr. P. J. Haler), a recent tour of the college revealed the high practical ideal with which the Committee determined to give effect to its considered policy. Here is a veritable palace of learning, stated to be the largest of its kind

the near future, to provide a swimming bath, two gymnasia, a sports' pavilion and other adequate accommodation. Indeed, in giving practical effect to its policy, the education authority has not confined itself merely to existing needs, but also has designed the various blocks of buildings "with reference as much to the future developments of the college as to its present requirements".

The plan of the main building is shaped like the letter H, and the ground floor contains a centrally placed assembly hall to seat 1,000, with a stage for dramatic performances at the west end and a projector room at the back of the balcony at the east end. The acoustics of this hall have been very skilfully considered. On the other side of the central corridor or foyer are the exhibition hall and the administrative offices. Both the ground and first floors of the east wing are devoted to the department of domestic science, whilst the art department occupies the second floor. The west wing provides accommodation

on the first two floors for the commercial department where the latest contrivances for mechanizing arithmetic may be seen. On the central portion of the first floor—reached either by stairs or lift—are the library, board room, Retail Trades and Commodities Room. Between the upper part of the assembly hall and the library is a wide corridor lined with many fine pictures. In fact, the portion directly over the foyer is called the Picture Gallery. Directly above the assembly hall on the second floor is the cafeteria and dining hall fitted with a complete kitchen unit.

Behind the main building and connected by covered corridors are the departments of science and engineering, with a car park between them. At present, these are on the ground floor, but the science block will eventually be enlarged by the addition of two more floors. It now comprises laboratories for biology, building science, chemistry and physics, all equipped with the most modern appliances. It is anticipated to develop specialized courses with particular reference to the needs of local industries, for in the neighbourhood there are several large manufacturing chemists, an important cement works and one of the largest factories in the country for the production of photographic materials. Co-operation with some of these has already been established.

In the engineering block are to be found workshops for carpentry, automobile construction, plumbing, electrical installation and machine tools, each of which is thoroughly equipped with the latest machinery, all unit driven. There are also a spacious drawing office and an applied mechanics laboratory. As in the case of the science department, it is hoped to correlate the work done with local industries, and already the Ford Motor Company is sending a large number of employees to the college for instruction.

Here, indeed, is a worthy institution wherein to "find out what a man can do and then teach him to do it better". F. G. W. B.

Excavations at Chandhu-Daro, Sind

CHANDHU-DARO, a mound site near Sukhpur in the Nawabshah District of Sind, was selected for investigation by the American School of Indic and Iranian Studies, with the active support of the Boston Museum of Fine Arts, in the hope that it would afford evidence bearing on the beginnings of the Harappa civilization, as known from the sites of Mohenjo-daro and Harappa in the Indus valley, or alternatively on the dark period between the disappearance of that civilization and the entry into India of the Aryan-speaking peoples at about 1500 B.C. The excavations have been conducted by Dr. E. J. A. Mackay, who described their progress to date before the Royal Society of Arts at a meeting on March 5.

The site of Chandhu-daro, situated east of the River Indus and eighty miles south-west of Mohenjo-daro, consists of a complex of two large mounds and one small mound. In ancient times they constituted a single city, which was cut right through by flood water of the Indus, a disaster which led to the city being abandoned. There is indisputable evidence that a similar disaster occurred on more than one occasion and as Mohenjo-daro also suffered similarly from flood on at least two occasions, it is now thought probable that the decline of this great civilization may have been due to the impossibility of occupying sites that were continually being surrounded by large sheets of water.

Although the city in size never approached that of Mohenjo-daro, a massive wall, averaging five feet wide and traced for eighty feet, which was among the earliest discoveries, suggests that the city was of considerable importance.

In order to ascertain whether the site had been occupied by any peoples earlier than those of the Harappa culture, Mound II was examined to its lowest levels by a pit which was taken down to water-level. It then appeared that some five thousand years ago Mounds I and II had constituted a single city, as already mentioned. In this part of the site, at least, no culture lay between subsoil water, which was reached at twenty-five feet below plain level, and the mound above. The lowest levels at Chandhu give the impression of being earlier than the strata immediately above water-level at Mohenjo-daro.

There are no less than five Harappa occupations. They were separated by layers of debris, and there could be no doubt, as there is at Mohenjo-daro, as to where one occupation ended and another began. Whether there are other occupations below water-level, it is impossible to say. The water-level has risen considerably. Of the five levels, the two uppermost on Mound II only have as yet been cleared, and the three lower are still to be examined. In the earlier of the upper Harappa levels the most striking feature is the existence of a bathroom in practically every house and the elaborate and careful system of drainage. There can be little doubt that bathing must have been a ritual. Where smaller and less important houses were not connected with street drainage, a system of cesspits or storage vessels was employed. In the main street of the second Harappa level a remarkable building was unearthed, which seems to have been some kind of a Turkish bath, with small chambers situated over flue holes. There is no other evidence that the ancient peoples of India used hot-air baths, but a somewhat similar building was discovered at Mohenjo-daro.

The buildings of the last Harappa occupation were the better preserved, but the area of occupation was very much less. Not long after the site had been abandoned, it was occupied again about 2000 B.C. by a small community of unknown origin, the Jhukar, living in houses of matting or mud. Of these dwellings all traces have disappeared, except the remains of the floors and the fireplaces, which were practically unknown among the Harappa people, who used open hearths.

After the disappearance of the Jhukars, Mound II was occupied once more by a small community, who used hand-made, polished, grey ware already known as the Jhangar culture from the site of that name in Sind.

The pottery from Chandhu-daro is perhaps the most interesting that has been found on any ancient site in recent years. The painted ware is quite

distinctive, and can be confused with no other ware. Unfortunately, few jars have been found complete. As on a similar ware at Mohenjo-daro, the motifs are painted in a thick black paint on a highly burnished red slip, which is almost like lacquer. Among the motifs is a quadruped with an exaggerated plume-like tail, a peacock with a crest of bush or tree-like form, while another bird has a crest which terminates in two sun-motifs. The sun apparently is conceived as a rotating sphere with prominences, while the association of the sun with vegetation is indicated by plant or bud designs, which represent these solar prominences. The larger storage vessels are frequently decorated around the upper part only. Incised decoration of pottery is comparatively rare.

The pottery of the Jhukar people in fabric, mode of decoration and polychrome colouring is quite different from that of their predecessors. Violet-black paint was applied to a thick cream slip. Below the decorative border are bands of red paint. Nor have the shapes any relation to the earlier wares. A clue to origin is afforded by a herring-bone pattern painted alternately in red and black, which recalls the much earlier ornamentation on wares from Tell Halaf in Mesopotamia and that found by Sir Aurel Stein at Zayak in southern Baluchistan. One triple vessel of the Jhangar grey ware also recalls a find made by Sir Aurel Stein at Shahi-tump in Baluchistan. This suggests that these people too may have entered India from the west, and possibly at a much earlier date than has been thought.

The seals used by the Harappa people are like those found at Mohenjo-daro; but those of the Jhukar are more primitive, and for the most part made of pottery. In the Harappa period, Chandhu-daro was a great centre of bead making, and beads have been found in all stages from the raw material to the finished bead. Among them were the cornelian beads ornamented with designs in white, such as have been found in Sumer, but now known to have been manufactured in India or by Indians.

Metal working in copper and bronze was a craft that was largely practised. Heavy blade axes, a scoop, new to the ancient world, knives, daggers, razors in three shapes, and hairpins all show great experience in metal working.

A large number of toys of various kinds were found, and nearly every child must have had a toy cart, usually made in pottery and closely following the real cart in detail. Pottery rattles, owing to their substantial make, are rarely found broken. Of objects connected with religion, the most interesting are the figurines of the mother goddess, which are very different from the cult images of the goddess found at Mohenjo-daro. They were without legs, but had a hollow base to stand on. Like other figures of the Harappa culture, they were richly loaded with jewellery and their ears were pierced for ear-rings. Little jewellery was found.

Although the unique objects found on the site naturally have remained in India, the Archæological Survey has been generous in the allocation of objects to the Boston Fine Arts Museum. This is the only collection of objects illustrative of the early Indian civilization on exhibition outside India, and it is to be regretted that no similar collection is to be found in the museums of Great Britain. The exploration of the many sites of importance in India should not be left to other countries, and no British expedition organized to work in this most promising field.

Canadian Hydro-electric Power Development in 1936

ALTHOUGH the actual output of electricity in Canada during 1936 reached the new high level of 25,493½ million kilowatt-hours, the year was not specially remarkable for progress in development of the available water supplies. The annual review of hydro-electric power progress, issued by the Canadian Minister of Mines and Resources on January 1 of this year, shows that a comparatively small addition was made to the preceding year's aggregate of water-power developed in the Dominion, which at the end of 1935 had attained a figure of 7,909,115 horse-power. New installations during the twelve months increased this by 36,475 to the new total of 7,945,590. This is a little short of 8 millions, and, as the estimated total available is fully 40 millions, represents barely twenty per cent of the country's resources.

Notwithstanding the relatively small increment for the year, there is a number of projects actually under way which will add materially to the aggregate during the course of the next year or two. The progress of hydro-electric development in Canada within recent years has been largely influenced by the conditions arising out of a period of restricted output, lasting from 1930 until 1933. Prior to 1930, a number of important installations had been made in order to keep pace with a steadily growing demand for power which, however, slackened and ceased about six years ago. It was not until May 1933 that the demand resumed an upward tendency which has continued. But it produced a corresponding relaxation of effort in regard to new enterprises, the effect of which has not yet quite dissipated itself, though there is every likelihood of its doing so in the very near future.

The new installations during 1936 consisted chiefly of additions to existing stations at High Falls (a fourth unit of 30,000 horse-power), on the Lievre River in the Province of Quebec, by the Maclaren-Quebec Power Co.; at Rat Rapids (a new unit of 1,750 horse-power), on the Albany River in the Province of Ontario; and at Ruth Falls (4,300 horse-power) on East River Sheet Harbour, Nova Scotia. Several small installations have also been completed in British Columbia.

The Quebec Streams Commission has continued to maintain satisfactorily the desired regulation of flow on all the controlled rivers in the province by means of its extensive system of storage reservoirs, of which there are now seventeen, some of them of considerable size. It is actively pursuing investigations in regard to other available storage sites with the view of adapting them to the same purpose.

BRYSSON CUNNINGHAM.

Science News a Century Ago

Baron Antoine Dubois (1756–1837)

BARON ANTOINE DUBOIS, the celebrated French surgeon and obstetrician, whose death occurred on March 30, 1837, was born at Gramat, a small town in the Lot Department near Cahors, on July 17, 1756. After commencing his studies at Cahors, he went to Paris at the age of twenty years, where, like three other famous French surgeons, Ambroise Paré, J. L. Petit and Desault, he had at first a hard struggle with poverty until Desault made him his assistant. In 1790 he was elected member of the Paris Academy of Surgeons and in the following year Louis XVI made him professor of anatomy. Shortly afterwards, he joined the army and served first at the military hospital at Melun and then as member of the Army Health Council and inspector of the Army of the Eastern Pyrenees, and took part in Napoleon's Egyptian campaign. In 1811, when chief obstetrician to the Paris Maternity Hospital, he was summoned by Napoleon to attend the Empress Marie Louise during the birth of the subsequent King of Rome, and for his services on that occasion, when he successfully performed version, he was made a baron of the Empire. During the years 1830 and 1831 he was dean of the Medical Faculty of Paris.

Dubois was a clear and concise lecturer, an excellent teacher and an unrivalled operator. As a surgeon he is best known for his operations of lithotomy, aneurysm and anal fistula.

A National School of Mines

"Mr. John Taylor, well known as a lecturer on mineralogy, and great promoter of the search for subterranean riches, is at present actively engaged in endeavouring to found a national 'School of Mines', for giving instruction in all that relates to the theory, as well as the practice, of mining operations. Such institutions have long been in existence in Germany, where they have proved of great utility" (*Mechanics' Magazine*, April 1, 1837).

Watch Making at Geneva

"This manufacture commenced in 1587 and in 1600 the town council legislated upon it. In 1685 there were counted 100 masters and 300 journeymen watch makers at Geneva, who turned out by hand 5000 watches yearly. There were also 80 masters and 200 journeymen jewellers. The trade continued increasing till 1789 when it was at its height. In that year the number of those engaged in it in the city alone was 4000, and 2000 in the suburbs and villages. There are not now so many hands engaged, though more watches are made; the diminution of manual labour being occasioned by improved tools and machinery, and abridged mechanism of the watch. There has been a great falling off in this manufacture but very lately it has rather revived again" (*Mechanics' Magazine*, April 1, 1837).

European Medicine in the East

IN the issue of the *Quarterly Journal of the Calcutta Medical and Physical Society* of April 1, 1837, Dr. Henry Hurry Goodeve, editor of the journal and professor of anatomy and medicine at the Medical College, Calcutta, makes the following observations:

"Within the last twenty or fifteen years Anglo-Indian medicine has advanced with rapid strides. The immense improvements that have taken place in the medical science in Europe have doubtless contributed to this desirable end; for even in these distant regions we feel in our turn (though at times somewhat slowly) the influence of scientific studies at home. Thus following the track of our European brethren, we have pursued the never failing indications of pathology in the investigation of diseases; and aided by our knowledge of the true state of the affected organs, we have been able to employ with manifold advantage the improved modes of treatment which modern practice has brought into notice. Among these improvements one article of medicine deserves special attention. The discovery of Quinine has wrought a greater change in the treatment of disease than perhaps any other remedy which was ever introduced into the materia medica, not excepting its precursor and progenitor, the Peruvian bark. Nowhere has this change been so manifest as in India. In this country it has created a completely new epoch in the treatment of fevers of every kind, but most of all in those of the remittent class, in which it has almost brought back the old bark practice, although Quinine is administered in these maladies upon totally different principles from those which guided the exhibition of the cortex Peruvianii."

The Tread-wheel and Health

THE following extract from the second report of the Prison Inspectors of the Home District published on April 1, 1837, for presentation to both Houses of Parliament expresses the opinion of the governor of the Coldbath-fields House of Correction as to the effect of tread-wheel labour on the health of the prisoners:

"We had much sickness during the late epidemic, both among prisoners and officers, namely, the influenza in its various stages. Where prisoners are exposed greatly to the atmosphere and draughts, as is the case here on the wheels and in the passages, it must be injurious to health. Their coming off the wheels warm, for relief, and sitting in that state in the stages, must be bad. I think tread-wheel labour injurious to the health of some of the prisoners —to corpulent, or infirm and aged, or tall persons; but not to boys, lads, or men of light weight, if in good health. I take every possible means to prevent the bad effects of the tread-wheel by a judicious regulation of the labour, and by observing any ill-effects it may produce on the constitution of the prisoners; and if necessary immediately calling the attention of the surgeon to any cases of the kind, or by relieving them myself, according to circumstances in various ways; either by diminishing the labour, increasing the diet (often including porter), placing them to work in the grounds, etc. I find that the men in general are greatly distressed after three months' continuous labour, but tall and heavy men in a less time.

"With regard to women I believe tread-wheel labour, if judiciously used, is highly beneficial to health; particularly in cases of disorderly women, prostitutes, etc., committed for periods not exceeding three months, and who generally come into hospital in a deplorable condition from drink and intemperance, and quit it in good health. But these work less than the men, who labour in the proportion of twelve on the wheel to six at rest; the women in the proportion of twelve on the wheel to twelve off."

University Events

CAMBRIDGE.—At King's College, the following have been elected into fellowships : K. C. Dixon and D. G. Champernowne. Mr. Dixon was educated at Haileybury College. He was placed in the first class in both parts of the Natural Sciences Tripos and was awarded an additional Harold Fry studentship in 1934 and 1935. Mr. Champernowne was educated at Winchester College. He was placed in the first class in both parts of the Mathematical Tripos and in the Economics Tripos, Part II. He was elected Wrenbury scholar in 1935, and in 1936 was awarded the Adam Smith Prize.

At St. John's College a Research Studentship and Research Exhibitions are offered for competition in July. One Strathcona Research studentship of the annual value of £200 is offered for competition among research students who are (*a*) Graduates of any university other than Cambridge, or (*b*) graduates of Cambridge who are not already members of St. John's College. The successful candidate, if not already a member of the College, will be elected for two years, subject as regards a second year of tenure to his continuing in residence and to the College being satisfied with his progress ; if he is already a member of the College, the tenure of the studentship will be for one year only. Two Strathcona exhibitions of the annual value of £40 are also offered for competition under the same conditions as the studentship. Further information can be obtained from the Senior Tutor, St. John's College, not later than July 1, 1937.

EDINBURGH.—The Senatus Academicus has resolved to offer the degree of LL.D. to the following among others : Prof. L. H. Baekeland, honorary professor of chemical engineering in Columbia University ; Sir William Bragg, president of the Royal Society ; Dr. Edwin Bramwell, a former president of the Royal Society of Physicians of Edinburgh ; Dr. Alexander Morgan, formerly director of studies, Edinburgh Provincial Training College.

LEEDS.—Dr. J. B. Speakman, at present lecturer, has been appointed to a readership in textile chemistry, and Dr. W. T. Astbury, at present lecturer, to a readership in textile physics.

Prof. W. MacAdam, formerly professor of clinical medicine, has been elected to the chair of medicine in succession to Prof. G. W. Watson, and Prof. J. le F. C. Burrow, formerly professor of pharmacology and therapeutics, to the chair of clinical medicine. To the vacancy caused by these changes, the Council has elected Dr. S. J. Hartfall, with the title of professor of therapeutics and applied pharmacology.

LONDON.—Her Majesty the Queen has been graciously pleased to signify her consent to receiving an honorary degree from the University. The conferment of the degree will probably take place in the autumn.

Dr. H. L. Eason has been appointed principal of the University from July 1, 1937, until September 30, 1941 (see also p. 539 of this issue.)

Prof. Samuel Sugden has been appointed as from October 1 to the University chair of chemistry tenable at University College. Since 1928 he has been professor of physical chemistry in the University in respect of the post held by him at Birkbeck College.

The title of reader in mining geology in the University has been conferred on Dr. W. R. Jones (Imperial College—Royal School of Mines) and that of reader in palæontology in the University on Dr. W. F. Whittard (Imperial College of Science and Technology).

A further donation of £2,500 has been received towards the Institute of Archæology Appeal Fund from the same anonymous donor who had already contributed £12,500. Since the date of this last gift, the donor has died, and it can now be revealed that it was Mrs. Mary Woodgate Wharrie. Mrs. Wharrie was among the earliest and most generous benefactors of the recently established Institute of Archæology. Her gifts were the determining factor in the decision of the University to rehabilitate St. John's Lodge, Regent's Park, as the temporary home for the Institute and, in particular, for the display and utilization of the large collections of material excavated by Sir Flinders Petrie in Palestine and presented to the University by the British School of Archæology in Egypt. On the occasion of the opening of the Institute by the Chancellor of the University, it is proposed to dedicate the main gallery to Mrs. Wharrie's memory.

On the occasion of the meeting of the International Council of Scientific Unions in London in April an honorary degree will be conferred on Prof. N. E. Nörlund, the president of the International Council, and director of the Geodetic Institute of Copenhagen.

The degree of D.Sc. has been conferred on the following : Miss M. S. Lacey (bacteriology), B. D. Bolas (botany), Miss D. L. Reynolds (geology), A. K. Denisoff (physics), S. R. Rao (physics).

OXFORD.—Dr. J. A. Douglas, Keble College, lecturer in geology, has been elected professor of geology and fellow of University College.

SHEFFIELD.—The Rockefeller Foundation of New York has made a further grant of £250 in aid of research in the Department of Pharmacology of the University.

Societies and Academies

Edinburgh

Royal Society, March 1.

R. A. HOUSTOUN : The time lag of the vacuum photo-cell. The image of an electric filament was swept over the cathodes of two photo-cells, a *KMV*6 and a *KV*6, at various speeds, and the constancy of the photo-electric emission tested. Down to a duration of illumination of $7{\cdot}4 \times 10^{-8}$ sec. the law of proportionality held for the *KMV* 6, but there was a slight breakdown in the case of the *KV* 6. If this is ascribed to the presence of a time lag or period of induction, the latter will be about 5×10^{-10} second (see also NATURE, 139, 29, 330 ; 1937).

W. O. KERMACK and A. G. M'KENDRICK : Tests for randomness in a series of numerical observations. In a series of unequal numbers, some (maximal numbers) are greater, whilst others (minimal numbers) are smaller than either of their immediate neighbours. A sequence of runs extending from a maximal to an adjacent minimal number is called a 'run'. The average length of a run is 2·5, and the standard deviation is $\sqrt{3/5s}$, where s is the number (assumed large) of runs from which the average has been calculated. Other properties of randomly arranged numbers are also given. These results will probably

be distributed by periodic or other regularities, and so afford tests of randomness.

A. C. STEPHEN: Production of large broods in certain lamellibranchs in relation to weather conditions. The fluctuations in the amounts of the broods of the littoral and sub-littoral species *Tellina tenuis* and *Tellina fabula* at Millport, Firth of Clyde, have been followed since 1926. There have been four specially large broods. Little or no correlation has been traced between these and the local sunshine and rainfall, but a very close connexion exists between the broods and temperature. The algebraic sum of the deviations of the monthly means from standard means has been used for comparison of temperature, sunshine and rainfall.

P. C. KOLLER: The genetical and mechanical properties of sex chromosomes. (3) Man. Two types of sex bivalent may be found at meiotic metaphase of man; one is asymmetrical and indicates the pre-reduction, the other is symmetrical and indicates the post-reduction of the structural inequality, which characterizes the sex chromosomes. The two types of sex bivalent suggest that the centromere lies in the pairing segment and crossing over may take place on both sides of the centromere. Genes which are localized in the pairing segment exhibit incomplete sex linkage. The occurrence of crossing-over in both arms of the pairing segment indicates that the total length of this region is more than 50 units, so that genes farthest from the differential segment should show very little sex linkage.

VERA FRETTER: The structure and function of the alimentary canal of some species of *Polyplacophora* (Mollusca). The buccal cavity leads into the œsophagus, which expands laterally into a small pair of anterior pouches and receives the ducts of a pair of posterior pouches ('sugar glands') which secrete a diastatic enzyme. In the capacious stomach the food is mixed with a proteolytic enzyme secreted by the digestive gland. The soluble products of digestion are forced into the digestive gland from the anterior intestine by the action of an intestinal valve or sphincter. In the extensive coils of the posterior intestine the fæcal pellets are elaborated. Structurally the alimentary canal shows remarkable similarity to that of the lower Gastropods.

H. W. TURNBULL: The revised complete system of a quadratic complex. A sequel to an earlier communication.

A. C. AITKEN: Studies in practical mathematics. (1) The evaluation with applications, of a certain triple product matrix. In the solution of equations, the theory of correlation and in other parts of practical mathematics it is often necessary to obtain the reciprocal array of a given array of coefficients, and sometimes to transform the reciprocal array further by multiplying it before and after by other arrays. The paper describes a method, suited for practical use, by which such threefold product arrays may be evaluated by a uniform reduction. The method is exemplified in typical cases.

Rome

Royal National Academy of the Lincei

(*Atti*, 23, 807–911; 1936).

E. BOMPIANI: Normalization of linear differential equations.

G. FANO: Algebraic surfaces and varieties in three dimensions with canonical curve sections.

F. SEVERI: General theory of the correspondences between algebraic varieties (1).

G. GIORGI: The postulates of the second theory of relativity.

G. A. BLANC: Presence of *Equus hydruntinus* in the quaternary gravels of the Aniene.

A. STELLA: Characteristics of the Italian metalliferous deposits in basic rocks.

C. CARBONARO: Completely derivable functions of one bidual variable.

S. CHERUBINO: Characteristic roots of holomorphous functions of matrices.

G. BEMPORAD: Development of the orbits of binary systems.

L. GIALANELLA: Meridian observations of Saturn, of Uranus, and of the moon in 1935.

G. AGAMENNONE: Comparison of the epicentres of two recent similar earthquakes.

F. ODONE: Absolute temperature T and the principal thermodynamic relationships.

A. BARONI: Chlorides of thiocyanogen.

S. BERLINGOZZI and G. FRANCINI NALDI: Researches on rotatory amino acids.

V. GAGLIOTI and D. GIGANTE: Contribution to the biochemical knowledge of bones during development.

G. CENTOLA: Relations between structure and mechanical properties of films and threads of acetylcellulose.

R. DE FAZI and F. PIRRONE: Chemical constitution of cholesterine (13). 13-18-Dimethyl-9-13-cyclopentane-5-6-dehydro-hydrophenanthrene-3 from cholesterine.

L. MAZZA: Galvanometer amplification by means of differential photo-electric cells.

G. TEDESCHI: Oxidation of monovalent nickel by the action of water in presence of CN^- ions.

R. SAVELLI: Observations on the chloroplasts of Cactaceæ.

G. COTRONEI and T. PERRI: Further researches on the embryonic compatibility and incompatibility in Amphibia studied by the method of grafting.

H. GROSSFELD: Permeability of cell tissues cultivated *in vitro* (see also NATURE, **138**, 31; 1936).

A. SPIRITO: Studies of embryology (1). The phenomenon of anærobiosis studied comparatively in petromyzonts and in anuran amphibians.

(*Atti*, 23, 915–965; 1936).

G. SCORZA: New contributions to the general theory of algebras.

F. SEVERI: General theory of the correspondences between algebraic varieties (2).

G. ARRIGHI: Problem of impulse in isotropic elastic bodies. Variations of thrust in a heavy liquid in equilibrium.

C. MORAIS: Spherical aberration of the fifth order of central systems.

A. BARONI: Oxidizability and structure of some industrial lamp-blacks.

G. COTRONEI and A. SPIRITO: Phenomena of embryonic and larval growth studied in the grafting of anurans and urodelans.

H. GROSSFELD: Discharge of protoplasm by removal of the electrolytes from the liquid medium in cells of tissues cultivated *in vitro*.

R. SAVELLI: Leucosterinoplast.

A. ORRÙ: Rate of growth of the hen's egg. Behaviour of the electrical conductivity of the albumen of the hen's egg with increasing and decreasing temperatures.

Forthcoming Event

Friday, April 2

PALÆONTOGRAPHICAL SOCIETY, at 4—(at the Geological Society, Burlington House, London, W.1).—Annual Meeting.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR SCIENTIFIC OFFICER (physics or engineering) for the Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, London, N.W.1—The Secretary (April 3).

LECTURER IN MATHEMATICS in the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3—The Principal (April 3).

CIVILIAN EDUCATION OFFICER (grade III—engineering or physics) in the Royal Air Force Education Service—The Secretary, Air Ministry (E.S.1), Adastral House, Kingsway, London, W.C.2 (April 5).

LECTURER IN DOMESTIC SCIENCE AND HYGIENE (woman) and LECTURER IN PHYSICAL SCIENCE AND HYGIENE (man) in the Normal College, Bangor—The Principal (April 7).

LECTURER IN GEOLOGY in the University of Aberdeen—The Secretary (May 7).

MYCOLOGIST at the Rothamsted Experimental Station, Harpenden, Herts—The Secretary (June 20).

LECTURER IN BIOLOGY (woman) in St. Peter's Training College, Peterborough—The Principal.

SUPERINTENDENT OF TECHNICAL DEVELOPMENT in the Survey Department of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1.

Official Publications Received

Great Britain and Ireland

Ministry of Health. Departmental Committee on the Cost of Hospitals and other Public Buildings. First Report: The Acute General Hospital. Pp. 84. (London: H.M. Stationery Office.) 1*s.* 3*d.* net. [222

Physical Society. Reports on Progress in Physics, Vol. 3. General Editor: Allan Ferguson. Pp. iv+394. (London: Physical Society.) 20*s.* net. [232

Department of Scientific and Industrial Research. Forest Products Research Records, No. 14 (Mycology Series, No. 1): Dry Rot Investigations in an Experimental House. By W. P. K. Findlay. Pp. ii+14+5 plates. (London: H.M. Stationery Office.) 6*d.* net. [232

London County Council: Horniman Museum and Library. From Stone to Steel: a Handbook to the Cases illustrating the Ages of Stone, Bronze and Iron. Third edition. Pp. 98+2 plates. (London: P.S. King and Son, Ltd.) 6*d.* [252

Report from the Select Committee on Medicine Stamp Duties. Pp. 13. (London: H.M. Stationery Office.) 3*d.* net. [13

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board for the Year ended 30th June 1936; with Report of the Director of Water Pollution Research. Pp. iv+56. (London: H.M. Stationery Office.) 1*s.* net. [13

Liverpool Observatory and Tidal Institute. Annual Report, 1936. Pp. 16. (Liverpool: Liverpool Observatory.) [13

University of London: University College. Annual Report, February 1936–February 1937. Pp. ii+171. (London: Taylor and Francis.) [13

Technical Publications of the International Tin Research and Development Council. Series A, No. 50: The Systems Tin-Germanium and Tin-Beryllium. By Prof. Dr. W. Guertler and M. Pirani. Pp. 24+4 plates. (London: International Tin Research and Development Council.) Free. [43

Ministry of Labour. Statement relating to Special Areas, including Memorandum on Financial Resolution to be Proposed. (Cmd. 5386.) Pp. 11. (London: H.M. Stationery Office.) [83

Scientific Horticulture: the Journal of the Horticultural Education Association. Vol. 5, 1937. Pp. 196+xxxii+20 plates. (Wye: South-Eastern Agricultural College.) 3*s.* 6*d.* net. [83

Other Countries

Publications of the South African Institute for Medical Research. No. 39: The Blood Groups of the Bantu of Southern Africa. By Ronald Elsdon-Dew. Pp. ii+221–300. (Johannesburg: South African Institute for Medical Research.) [232

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