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Armaments and the Scientific Worker

THE recently issued report* of the Royal Commission, which has dealt with the private manufacture and sale of munitions of war, contains a number of special points of particular interest to the scientific worker. A considerable amount of evidence was laid before the Commission designed to show that the manufacture of armaments should be concentrated in Government hands to promote the development of research, design and invention. It was argued that centralization of research work under unified control prevents dissipation of effort and that closer contact is possible between research and experimental work in Government stations, which have greater facilities than private establishments for experiment. Similarly, it was urged that money is more readily available for research in Government establishments, where there is not the necessity to visualize a prospect of dividend on capital that there is with private enterprise, as well as the danger of prejudicing the interests of the State if a private manufacturer does not develop a new invention which may not be to his own advantage, the motive of profit-making in certain circumstances tending to retard the development of new ideas.

Other evidence brought before the Commission denied that the development of research, design and invention in the matter of armaments would be facilitated by nationalization. It was stated that research work is cramped within Government departments, and that in peace time funds for research are more readily made available by private industry than by the Government. It was also argued that the supply of war material by Government establishments alone would result in sound but mediocre material because the atmosphere and conditions of Government service do not favour the development of new ideas. Moreover, since discovery, research and development of new ideas result from individual effort, they do not lend themselves to centralized organization, and Government employees do not seek to assume additional responsibilities or incur the risk of putting forward new ideas which may be regarded as impracticable in high quarters. Not only does competition under private manufacture provide a strong incentive to individuals to find new and improved devices, but also research conducted by commercial undertakings in non-military matters is just as likely to result in discoveries of military value, the tank itself being cited as an idea which emanated from a private engineering firm.

The report itself makes no pronouncement either upon the separate aspect of the case of the opponents of private manufacture based upon its alleged inefficiency and the lack of opportunity for fully developed research, or upon the counter arguments in this matter of the supporters of the present system. Neither side refers to the ethical questions of the participation of men of science in preparations for war or the possible formulation of a professional code of ethics which at the present time is seriously occupying the minds of scientific workers whose participation is essential under either system of control. None the less, this is probably the most important aspect so far as the stimulation of invention and discovery is concerned.

Disgust and dissatisfaction at the prostitution of scientific effort to the elaboration of even more destructive weapons is now too widespread to be disregarded. Any system, whether national or international, which encourages unlimited misuse

* Royal Commission on the Private Manufacture of and Trading in Arms (1935–36) : Report. (Cmd. 5292.) Pp. 101. (London : H.M. Stationery Office, 1936.) 1*s.* 6*d.* net.

in this way can scarcely long escape repudiation and overthrow. While scientific workers are of no two minds as to the necessity for whatever armaments we must have being efficiently produced and maintained, they would find a very considerable support for opposition to any system which demanded their efforts in the development of offensive, as opposed to defensive, weapons indefinitely. Moreover, the scientific worker in matters of national defence should require no further stimulus than his specific occupation if those ethical needs are satisfied. If, on the other hand, they are left unsatisfied, it is doubtful whether any system of armaments manufacture can supply a stimulus as effective.

The report of the Royal Commission accordingly will be something of a disappointment to those scientific workers who are concerned with the ethical aspects of their participation in the preparations for national defence. It gives no lead on certain of these questions of research and development which, apart from the ethical aspect, are equally to be encountered in other fields of industrial and scientific research. At least, however, it emphasizes once more that the task of constructing world peace involves not merely the abolition of war, but also the far-reaching and impartial study of all its many causes, and not least that of the contribution and organization of the armaments industry itself.

Genetics and Race

IN the classificatory systems of a number of sciences the term 'race' occurs. Its meaning differs somewhat from science to science, but in all it has two main connotations, one being community of descent, the other distinctness from other races. Years ago the term signified something rather definite, but as time has passed and knowledge has advanced, this has given place to something much more vague. In general biology, for example, 'race' has now been largely abandoned in favour of 'sub-species'—a term much more in harmony with the concept that it is used to portray.

So long as the definition of race in the usage of one science does not invade the territory of another, it is a matter of no great importance if there are as many definitions as there are sciences; but if and when the term race as used by the physical anthropologists, for example, comes to have genetical implications, then it is reasonable for the geneticist to express the view that the anthropologists' definition must neither disregard nor offend genetic principles. This it does, for the anthropological use of the term dates from the time when it was believed that organic inheritance was of the blending variety, so that a mixed population would speedily approximate to a characteristic uniform type. This assumption has been shown to be incorrect by the establishment of the Mendelian basis of inheritance, and it is now known that constellations of characters necessarily become broken up and their ingredients shifted back and forth, combined and recombined, when, consequent upon the removal of isolation and inbreeding, crossing occurs. Furthermore, the assumption that man's evolution has taken the form of a separation into discreet isolated units is also incorrect, since migration and crossing have been operative for tens of thousands of years, so that, whereas the evolution of most animal types is divergent, that of man has been what may be called reticulate.

This was the reason for a joint meeting on September 11 of Sections H (Anthropology) and D (Zoology) of the British Association at Blackpool, at which the speakers were primarily concerning themselves with the question of whether or not the anthropologist's definition of race required modification in consequence of recent developments in genetics. But no one at this crowded meeting was unaware that the speakers were indirectly commenting upon the exploitation of the race concept by politicians who apparently are deliberately confusing linguistic terms such as 'Aryan', cultural terms such as 'germanic' and genetic terms like 'Nordic' by using them synonymously. It undoubtedly is the case that the term 'race' is now being used in a pseudo-scientific sense to further purely political interests, and this being so, it behoves all scientific workers—anthropologists, ethnologists and the rest—to respond to the demand on the part of the general public for guidance concerning the quality of the pronouncements of those who claim scientific

endorsement for their own peculiar attitudes toward such matters as territorial readjustment, immigration quota or the relative intellectual pre-eminence of certain national groups.

The impression left at the end of this meeting was that the anthropologist's definition of race has genetical implications, that it has been established that the rise of modern genetics has necessitated a thorough overhaul of the basic concepts of physical anthropology, that the techniques of genetics should now be added to those of the anthropologist, and that genetical analyses of human differences and the correlation between them should be undertaken, and that, as applied to mankind, it is now quite impossible to give a scientific definition to the term 'race' since this has connotations which do not apply in human species. Now that the politician has appropriated the term, it is time for the man of science to relinquish it.

Sixty Years of Physical Science

Recollections and Reflections

By Sir J. J. Thomson. Pp. viii + 451 + 10 plates. (London : G. Bell and Sons, Ltd., 1936.) 18*s*. net.

IT is hard to believe that Sir Joseph Thomson will enter the ranks of the octogenarians on December 18—he has given, and is giving, so much to the world that it may very well happen to him as to Voltaire, who awoke one morning to find the world celebrating his eightieth birthday, he himself having scarcely had leisure to realize that he had reached middle-age.

Sir Joseph has seen many cities and many men ; and, in the spirit of the Spanish proverb which says that "He who would bring back the wealth of the Indies must take that wealth with him", we should expect Sir Joseph's reflections on his voyagings in thought and in space to yield a rich harvest indeed.

Nor shall we be disappointed. The changes which he records are, in the total, almost incredible in their extent and variety. In that Palmerstonian world into which he was born, the University of Cambridge was still governed by those medieval statutes of the workings of which the late Dr. John Venn has left so vivid a picture. Memories of those days, when Hall was at 4, when water, of doubtful origin, was carried from pumps, and smallpox patients went through the various stages of their disease in bedrooms opening on a common staircase, still lingered on in that yet far-off Cambridge of 1876, when J. J. Thomson entered his name on the books of Trinity College. Sixty years have passed and the undergraduate of 1876, now Master of Trinity, has kept every term since then, and has been in residence for some part of every long vacation. Nor, as he remarks, can he remember any day during the last sixty years when his work has been interrupted by bad health. A remarkable record, and one which has probably been surpassed only by old Dr. Routh (1755–1854), the venerable President of Magdalen, who walked over Magdalen bridge, an undergraduate of fifteen years of age and thereafter left Oxford but once, on an abortive trip to France.

The Cambridge of 1876 was awakening to the importance of physical science. Maxwell had been appointed to the Cavendish chair in 1871 and the quadrant electrometer loomed large in the land. Maxwell himself was deeply immersed in the study of the Cavendish papers, and was enthusiastically repeating those remarkable experiments in which Cavendish had arrived at correct notions of the meaning and magnitude of electrical resistance by making of himself a human galvanometer, estimating current strength by the intensity of the shock he felt in his elbow when the current was discharged through his body. Distinguished visitors were called on, very much against their wills at times, to repeat the experiment, and Sir Joseph's recollections of the period range easily from topic to topic, now sketching Maxwell's work, now moving to a masterly account of Cavendish's meticulously accurate experiments and queer personality and again moved by a recollection of Cavendish's 'gar-do' methods, as the Scots phrase has it, making a neat comparison of Cavendish's and the late Lord Rayleigh's experimental technique, for each experimenter had the gift of seeing what was the vital point in the experiment, so that "though the apparatus as a whole might look untidy and haphazard, the parts that really mattered were all right. It was a 'rum 'un to look at, but a beggar to go'."

Sir Joseph's interests are catholic and his memories are ranging. Figure after figure comes to life, invoked by the power of a kindly memory and a genial pen, and we hear much of the giants of past days, and something of those who are still with us. The portraits of Butler, Thompson and Whewell, Sir Joseph's predecessors in the mastership of Trinity, are skilfully etched, and it

is pleasant to recall the personality, sketched from first-hand knowledge, of the Master who reminded his fellows that "we are none of us infallible, not even the youngest". Sir Joseph notes that Thompson had a liking for puns and instances his comment on Courvoisier's execution: "every valley shall be exalted". It would be interesting to know his views concerning the authenticity of what Dean Merivale, who credited the saying to Thompson, regarded as the best classical pun on record. In Merivale's day, a certain fellow named Money retired, took to himself a wife, and developed uxorious habits. The lady duly became as one of those who love their lords and, as the event approached, so waxed Money's uxoriousness. "Quite so," said Thompson, "crescit amor nummi, quantum ipsa pecunia crescit".

But, though Cambridge claims sixty years of Sir Joseph's working life, a portion of it, and that not the least important, lies outside the pale of Cambridge, for Manchester and Owens College claim a share in the shaping of Sir Joseph's genius.

Manchester was a remarkable centre of scientific activity, and the Manchester Literary and Philosophical Society, founded in 1781, had, in the eighteen fifties, three quarters of a century of fruitful work on which to look back. Dalton, Joule, Sturgeon and Henry are names indissolubly associated with Manchester, and the educational influence of the city was further strengthened by the foundation in 1851 of the Owens College, John Owens, a Manchester merchant, having left his estate to be devoted to the establishment of a College free from religious tests. The College, housed in Cobden's old house in Quay Street, was struggling to prosperity when J. J. Thomson entered in 1871. Greenwood was its principal, Barker its professor of mathematics, of whom Sir Joseph remarks, "I have never known a better teacher of mathematics than Barker, and in some respects no one so good". Roscoe taught chemistry, Balfour Stewart physics, Osborne Reynolds engineering; and when we are told that W. C. Williamson took all natural history for his province, that there was Stanley Jevons for logic and economics, Adolphus Ward for history and English, and Bryce for law, it is obvious that Sir Joseph is making no overstatement when he says that "though Owens College was badly housed, no university in the country had a more brilliant staff of professors".

It is interesting to learn that Sir Joseph's intention was to take up engineering as a profession; to that end his first three years at Owens College were spent mainly under Osborne Reynolds, "one of the most original and independent of men, who never did anything or expressed himself like anybody else", and it was not until he had received a diploma and a scholarship in engineering that the young student turned his energies towards the acquiring of a mathematical scholarship at Trinity College and embarked on a career which has so profoundly affected the thought of the age.

The hundred or so pages that Sir Joseph devotes to the story of the advances made in physical science in his day end all too soon. It would be difficult to find, within a compass so restricted, a clearer or more enthralling account of the exciting happenings of the days that heralded the discoveries made in our own generation.

Sir Joseph was, perhaps, fortunate in his age; as he points out, the discovery of Röntgen radiation coincided most happily with the advent of research students at the Cavendish Laboratory, and "to have come upon a method of producing conductivity in a gas so controllable and so convenient as that of the X-rays was like coming into smooth water after long buffeting by heavy seas". The discovery of the electron, the first and most famous of a long series of particles, was not long delayed, and was announced at the historic Friday evening discourse at the Royal Institution on April 29, 1897.

The electron, positive rays, isotopes; radioactivity, argon, relativity, electron diffraction—the story of these discoveries, discoveries in which the Cavendish Laboratory has played so dominating a part, is unfolded in a pleasantly easy fashion that reminds us that Sir Joseph Thomson is a great teacher, as well as a great pioneer of discovery; and withal so critical that we are in no danger of forgetting his own wise saying that a scientific theory should be considered as a policy rather than a creed.

In the hurly-burly of modern discovery, we are apt to lose sight of the great volume of work associated with Sir Joseph's name which bears some marks of the influence of his great teacher, Routh. Vortex rings are perhaps not so fashionable as they were fifty years ago, but his applications of Lagrangian methods to problems of physics and chemistry are as fresh now as they were in 1884, and the connoisseur in such matters does not permit the modest little volume containing the exposition of these methods to gather dust upon his shelves.

Much remains that can be no more than noted in passing—poignant memories of the years of War, recollections of visits to America, impressions of adventures in the region of psychical research.

We owe much to Sir Joseph Thomson, and these "Recollections and Reflections" add to our debt. It is impossible to close the book without an increased sense of admiration for a great genius, of affection for a wise and kindly personality.

A. F.

King Coal

Coal:
Its Constituents and Uses. By Prof. William A. Bone and Dr. Godfrey W. Himus. With a supplementary Chapter upon Fuel Economy and Heat Transmission in Industrial Furnaces by Dr. Reginald J. Sarjant. Pp. xvi+631+22 plates. (London, New York and Toronto: Longmans Green and Co., Ltd., 1936.) 25*s*. net.

THIS important work by very capable authors is one of the most complete and exhaustive treatises on the subject of the constitution and use of coal which has appeared in the English language.

The subject of coal, from whatever aspect one views it, is of outstanding consequence to all students of economics, for, as is well said in the introductory chapter, "the overwhelming supremacy in ship-building and mercantile marine which the United Kingdom had established over all nations by the end of the nineteenth century, was due to cheap coal and iron, favourable geological position, climatic conditions, combined with the policy of free imports".

The authors do not mince matters; it is clear that they are ardent advocates of free trade—and who shall blame them: "the adverse effects of the recent shrinkage of international trade," they say, "have undoubtedly been accentuated since 1931 by the country's departure from free trade", and they advance good reasons for the faith that is in them. They point to the important fact that "the continued production of relatively cheap coal remains the keystone of her [Great Britain's] whole economic structure"—would that our legislators were of like opinion—and that "the World's markets are now in the grip of a pernicious economic nationalism; lofty tariff-walls, import-quotas and licenses, and restrictions upon the exports of currencies have combined to hold up the free exchange of goods without which world prosperity cannot be restored". The reviewer is of like opinion, but the difficulty is to determine what action our country ought to take in respect of these barriers to free trade erected by other nations. Every thinking person ought to agree that "neither dear coal nor monopolistic methods will solve the industry's difficulties", though, alas, the trend of present-day legislation is in the direction of such methods.

But this survey of the economic position is merely of an introductory character. The work ranges over a far wider field, dealing, well and truly, with such matters as that of the origin and formation of coals of all kinds; of the coalfields of Great Britain, of weathering and spontaneous heating; of the smoke nuisance and its abatement; of the production of oil from coal; of combustion and heat transmission; of coke, gasification, fuel economy in the manufacture of iron and steel; of power production from coal and of domestic heating.

It is a work which should occupy an important niche in the library of every scientific worker, manufacturer, chemist or engineer—and, I think we may add, of the would-be statesman! If one is not in entire agreement with all the statements and conclusions of the authors, that fact does not in any way detract from one's appreciation of the value of their admirable work. It might, for example, be pointed out that one of the reasons advanced to account for the decline in output of coal (p. 19), namely, fuel economies in power production in iron and steel manufacture, and in carbonization processes, does not accord with Jevons's doctrine to the effect that economy in use of an essential commodity is not conducive to decline in the aggregate consumption of that commodity, but the reverse.

The authors, too, scarcely do justice to the subject of low-temperature distillation of coal, for whilst they state (p. 234) that if the resultant semi-coke "could be made available in adequate quantities at a price comparable with that of a good house-coal, the domestic smoke problem would soon be in a fair way to solution"; yet earlier on in the work (p. 24) they severely criticize the possibility of supplying 30 million tons of semi-coke annually, without advancing any argument in support of their contention which cannot be contraverted. For example, they state that the fuel oil obtained in the distillation is of "inferior quality"; the answer to this is that it is of a quality satisfactory enough to permit of its use by the Royal Navy. Again, that "the transport of vast amounts of solid fuel of lower density than coal would involve formidable difficulties especially in the Metropolis and other large cities". It is difficult to imagine why, seeing that the transport of the semi-coke would present no greater difficulties than in the case of the transport of the gas-coke at present supplied in large quantities. There is no reason why the low-temperature distillation of coal should not be carried out at gas works.

The assertion in regard to the advantage of oil over coal as a marine fuel, namely that "in view of the World's assured abundance of petroleum for the next generation or two there seems little

prospect of raw coal recovering what it has lost in that direction", is scarcely warranted. The late Sir Charles Parsons and others, of whom I was one, calculated, some ten years ago, that at the prices then ruling coal, were it used in the most economical way, that is, on chain grates under tubular boilers, with high-pressure steam (600 lb. per square inch and above) to drive turbines, after making due allowance for flexibility in use, saving in labour and gain in space, the advantages rightly claimed for oil, it would be more economical to use coal than oil. I believe that when this fact is fully realized by ship-owners, there will be a return to the use of coal.

The authors are in error (p. 29) in their account of how the chemical survey of the coalfields of Great Britain came to be inaugurated. The Fuel Research Board (which I suggested, in a memorandum drawn up for the guidance of the late Lord Haldane, should be set up for a period of five years to carry out scientific investigatory work for the "Coal Conservation Commission", of which Lord Haldane was chairman and I was a member) consisted of Sir George Beilby, Sir Charles Parsons, Mr. (afterwards Sir) R. Threlfall and myself; following upon a discussion with Prof. R. V. Wheeler, I brought before the Board the subject of a chemical survey of the coalfields and it was agreed to have such a survey carried into effect.

The information contained in Chapter iii of the book relating to the origin, formation and classification of coals is not quite correct in several instances. Thus, the authors are wrong in believing that coal does not exist in any of the geological systems older than the Carboniferous Age. Humic coals exist in the Devonian formation, for example, in the coalfield of Bear Island in the Arctic regions, where seams of 3 ft. 6 in. thickness occur.

In their description of the plants of the Carboniferous period which went to form coal, the authors might have mentioned the fact that the vegetable forms which flourished in the carboniferous period were not entirely of the giant club moss and tree fern, *Lepidodendron* and *Sigilaria* types, for an important constituent in some coals is a true forest tree, *Cordaites*.

On the subject of the origin of anthracite the authors are somewhat hazy (pp. 35, 87). As Strahan pointed out (A. Strahan and W. Pollard, "The Coals of South Wales . . ." *Mem. Geol. Survey*, 1908) the anthracites of South Wales were not derived from humic coals; the mother substances of the two coals differ in the nature of the vegetation of which they consisted or in the biochemical changes to which they were afterwards subjected. He emphasized the low ash content of these anthracites as pointing to the existence of a special type of mother substance. The authors say (p. 87) that "other reasons can be assigned for the lower ash content in question" but do not inform us what the reasons are.

But these are all comparatively inconsiderable errors and omissions. Upon the subject of the fusibility of ash in coal—a very important item in regard to the selection of coals for raising steam, especially where forced draught is employed—as the authors (p. 126) rightly say, "our knowledge is not sufficiently definite to warrant the laying down of any precise rules", though possibly it is related to the fusibility of alumina silicates. They have observed that it increases up to a certain point, "sometimes with its ferruginous character, sometimes, however, with its lime content, and, speaking generally, with the content of some 'most variable' constituent".

The exigencies of space do not permit of further perusing the fascinating subject of the chemical composition of coal, so ably and clearly and exhaustively treated in Chapters ix, x and xi, in which the work of Bedson, Burgess, Wheeler, Porter, Taylor, Discher and Bone, and other workers on the subject is fully discussed.

In regard to the subject of the action of oxygen at low temperatures on coal: the oxidation of coal is, as is now generally accepted, the cause of gob fires, but it cannot be accepted that "anthracites and anthracitic coals are so little affected that they may be considered as practically immune" (p. 194). I used to hold this view, until actual instances of spontaneous heating of anthracite in the mine, not only in the United States of America, but also in one case in a South Wales anthracite mine were brought to my notice.

Concerning the smoke nuisance, it was estimated, some years ago, that the material damage due to this cause in London alone amounts to £4,000,000 annually, and in Manchester, to £1,000,000 in addition to the "immeasurable evil effects of smoke and fog upon public health" (p. 218), a position which would be greatly aggravated by the establishment of super power stations in the proximity of our large towns were it not for the fact that they are compelled to adopt remedial measures. Such a station may burn upwards of one thousand tons per day (p. 231) with the resultant formation of 45 tons of sulphuric acid, 3–7 tons of nitric acid, and about 0·5 ton of hydrochloric acid, the danger from which being the fact that these deleterious substances are emitted from an area of a few hundred square yards instead of from five square miles of a town consuming the same amount of coal in its domestic fireplaces. It is gratifying to learn, however, that "a substantially complete removal is obtained at Fulham and at Battersea

power stations by skilfully devised abstergent processes".

The authors deal consummately with the subject of the by-products derivable from coal; of particular interest in this respect is their account of a method of producing *methanol*, a possibility which has been explored since the War, namely, the pressure-catalytic-synthesis of methyl alcohol ('Methanol') from carbonic oxide and hydrogen contained in 'water gas', by exothermic action. A quite recent development of this process—the Fischer-Tropsch process—has resulted in obtaining thereby light oils, waxes and heavier oils, which by another process of treatment can, according to Prof. Fischer, be converted into lubricating oils. This process for the purposes of oil and petrol production may turn out to be a formidable rival to that of the hydrogenation of coal.

But I must bring this review to a close, however enthralling the subject. Enough, it is hoped, has been said to point to the catholicity and profundity of the work and to induce all interested in the subject to read it for themselves. The style is lucid and easy. To each chapter is appended an excellent bibliography. The illustrations are clear and helpful, and the tables, of which there are no less than 136, are not the least valuable part of the work—a work on which the authors are to be congratulated as well as the publishers. R. A. S. REDMAYNE.

Properties of Carbon Dioxide

Carbon Dioxide

By Prof. Elton L. Quinn and Charles L. Jones. (American Chemical Society, Monograph Series, No. 72.) Pp. 294. (New York: The Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 37*s*. 6*d*. net.

THIS book is one of the American Chemical Society's valuable series of monographs which fulfil the dual purpose of presenting the available knowledge on the particular subject in a form generally readable by the scientific worker, and of promoting research by furnishing a well-digested survey of the progress already made in the field and by pointing out directions in which investigation needs to be extended.

In the present monograph, a survey has been made of physical, chemical and physiological properties of carbon dioxide, which should prove useful and suggestive, but the reviewer considers that there is a lack of proportion in the monograph as a whole and that too much space has been allocated to the three chapters on the commercial production and application of carbon dioxide in liquid and solid form. It may be mentioned that the two most important applications are the carbonation of beverages, for which the liquid is employed, and the refrigeration of ice cream, which requires the solid form. The possibility of commercial application also appears to have influenced somewhat the selection and arrangement of the scientific data, due possibly to the fact that while one of the authors is a professor of chemistry the other was formerly chief engineer to the American Dry Ice Corporation.

In the first two chapters are found the scientific and industrial history of carbon dioxide and an account of its occurrence and functions in Nature. A later chapter of ten pages deals with carbon dioxide in relation to vital processes. Since carbon dioxide is not an active compound, it is perhaps not surprising that twenty-three pages have been found adequate to deal with its chemical properties. The authors themselves point out that the purpose of this chapter is to consider many of the acidic reactions in aqueous solution and to deal also with some reactions taking place in the dry gas. Physical properties are described in great detail in a chapter of seventy-nine pages, but here the authors confess that selection of the best and most reliable physical data is most difficult, and in many cases practically all the recorded data have been included and it has been left to the reader to select those he considers the most useful. The remaining three chapters, dealing with manufacture and commercial applications, comprise nearly half the book, although the authors state in their preface that they have made no special effort to paint a picture of the carbon dioxide industry as it exists to-day.

From the preface also it appears that difficulty was experienced in presenting "a well co-ordinated discussion" of "such widely divergent ideas as the natural occurrence of carbon dioxide in Yellowstone National Park, the treatment of skin diseases with solid carbon dioxide and the blasting down of coal with the liquid form". It is suggested that the difficulty has arisen by failure to realize that carbon dioxide itself is the only co-ordinating factor, and whatever ramification the subject may possess it should be possible to adhere to the two purposes which this series of monographs seeks to fulfil. R. T.

Vitamine und Mangelkrankheiten:
ein Kapitel aus der menschlichen Ernährungslehre. Von Dr. Hermann Rudy. (Verständliche Wissenschaft, Band 27.) Pp. ix + 160. (Berlin: Julius Springer, 1936.) 4.80 gold marks.

THIS little book, which is of a size and price that would cause it to be sold for about 2*s*. 6*d*. in Great Britain, avoids many of the characteristics of current German scientific publications. Being of a semi-popular nature, it quite rightly refrains from giving detailed references and also, for the most part, investigators' names.

Few errors have been detected in the text, but the formula given for calciferol is now (and had been for months before this book was published) known to be inconsistent with experimental facts, which demand the presence of a methylene group and three conjugated double bonds. On the other hand, the recent work of Dam and his associates, leading to the recognition of an anti-hæmorrhagic factor, vitamin K, is given notice.

Dr. Rudy's observations (pp. 143 *et seq.*) on "Die Vitamine als Heilmittel" are particularly interesting and significant. Without at any point departing too ostensibly from current orthodox pharmacology, he gets extremely near to suggesting that the vitamins may be regarded, and used, as individual specific therapeutic agents, on the basis of their established physiological action rather than of their 'normal' role in 'natural' nutrition. So far, this view has only been tentatively and timidly adumbrated in speculative or controversial articles, but seldom, if ever, put forward in print for serious consideration by those who direct official medical and biochemical opinion. That it should now be implied or expressed in a book, and in a German book at that, seems to the reviewer a sign of the times. A. L. B.

Memoir on Fossils of the Late Pre-Cambrian (Newer Proterozoic) from the Adelaide Series, South Australia
By Sir T. W. Edgeworth David and Dr. R. J. Tillyard. Pp. xi + 122 + 13 plates. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co., 1936.) 7*s*. 6*d*.

THIS volume appears to have been issued as a memorial to the late Sir Edgeworth David. It gives a fuller and more detailed account of the work published in 1928, of which a notice appeared in NATURE (**123**, 659). The supposed fossils were found in the Adelaide Series near Adelaide, and are regarded as indicating the existence of Algæ, Radiolaria, annelids and arthropods in pre-Cambrian times. The specimens which have been seen in England are far from convincing, but it is claimed that as the result of the mass effect of a very large collection "no Australian scientist, whether palæontologist, zoologist, or geologist, who has taken the trouble to study the specimens, has any doubt whatever as to their being genuinely organic".

The chief addition in this volume is an account of the supposed arthropods by Dr. R. J. Tillyard. He maintains their arthropod nature on the grounds that the specimens, although fragmentary, do show evidence of bilateral symmetry, segmentation, segmented appendages and sculpture. After comparing them with various groups of arthropods, he concludes that they show some relationship to the Eurypterida, but that they are more primitive than any known arthropods, and must be placed in an independent class, since the prosoma is formed of distinct segments, each with a pair of appendages. The abdomen is regarded as formed of seven segments, but without segmented appendages. The restorations give a clear idea of Dr. Tillyard's interpretation, but we cannot test their validity from the evidence of the specimens figured. An excellent portrait of the late Sir Edgeworth David forms the frontispiece to the volume.

Ziema:
Fizyka globu, mórz i atmosfery. Napisał Dr. Edward Stenz. (Z Dziedziny Nauki i Techniki, Tom 11.) Pp. xiv + 303 + 26 plates. (Warszawa: "Mathesis Polskiej", 1936.)

THIS comprehensive Polish work on the physics (and incidentally much geology) of the globe, the sea and the atmosphere is a noteworthy publication and does credit to its author and his nation. It opens with a brief history of astronomy with reference to the earth and its relation to the sun, moon and planets. This is followed by a sketch of the geological epochs and such physical and chemical considerations as the magnetism and composition of the interior of the earth.

The section devoted to the sea is concerned with its magnitude and saline contents, and with tides and inundations. The role of the atmospheric envelope and the stratosphere and phenomena associated with them are considered, and in his final section the author discusses various cosmic phenomena, the age and probable fate of the world. Discoveries by Polish savants are referred to in detail and emphasis is given to matters of direct interest to Polish students. Thus, illustrations and examples are drawn wherever possible from local sources.

Food and the Principles of Dietetics
By Dr. Robert Hutchison and Prof. V. H. Mottram. Eighth edition. Pp. xxvii + 634 + 3 plates. (London: Edward Arnold and Co., 1936.) 21*s*. net.

WHEN this work was first published, thirty-six years ago, little attention had been given in Great Britain to scientific problems relating to food and human dietetics. The authors were among the pioneers in this field, and their work greatly assisted in creating new interest in the subject. In the eighth edition, now available, the history of dietetics is outlined in a new chapter in which it is pointed out that "If the nineteenth century was the quantitative epoch of dietetics the present century has so far been a qualitative epoch". The great advance of knowledge of food and nutrition has necessitated a number of changes and additions, and these will serve to maintain the position of the volume as a readable account of human foods and principles of feeding, as well as an authoritative work of reference.

Soil Science in the Twentieth Century*

By Prof. J. Hendrick

MOST of our scientific knowledge of the soil has been built up during the past century. It was only with the development of modern science, and especially of chemistry and geology, that such knowledge could advance, and it was about a century ago that our early knowledge of the chemical composition and mineral constitution of the soil was built up. This knowledge has been advancing ever since but with particular rapidity during the present century.

Soil science in Great Britain was in a comparatively stagnant state at the beginning of this century. Britain had done much in the development of the fertilizer industry, though even in this, while other countries were advancing rapidly, we had been falling somewhat into the background during the last quarter of the nineteenth century.

A comparison of the text-books on agriculture and agricultural chemistry of the beginning of the century with those of the present day will illustrate the great change in outlook on soil science. There were no British text-books on soil science in 1900. Any text-books on this subject in English were American. Our knowledge of what was being done by soil investigators abroad was not extensive; of what was being done in Russia we knew nothing.

Britain is a comparatively small country falling within ten degrees of latitude, with a climate which is in all parts temperate and humid and with a rainfall which is well distributed throughout all seasons of the year and which varies from moderate to high. The soils of Britain had not been studied even over the whole limited range of the country, but almost entirely in a small region in the south-east and mainly at Rothamsted and Woburn. These were looked upon as typical soils, and all others were supposed to be more or less similar. If that was not definitely stated, it was tacitly assumed. It may be said that until the present century, and even until the second decade of the present century, our view of soils was narrow and insular. All others were expected to conform to "This blessed plot, this earth, this realm, this England", and it was a most blessed plot of the south-east of England which was the standard.

We did ourselves no good service from an imperial point of view by taking such a narrow and insular view of soils. While Britain is a small country of limited latitude and climate, the British Empire exists in every latitude and every kind of climate. In agricultural science and not least in soil science, great sections of the British Empire, not merely Canada, but Australia and South Africa as well, came to look to the United States rather than to Britain for information and guidance.

There are two great countries which, unlike Britain, extend through wide ranges of latitude and climate. These are Russia and the United States. Russian territory extends from arctic tundra to the subtropical, and embraces every kind of climate from warm humid and cold humid to arid and desert. The same is true of the United States, especially if we include Canada, which, in this respect, is in very close association with the United States, whose workers keep in view the soils of the whole North American continent.

The scientific work of the United States is published in English and is therefore always easily accessible to us. Russia, on the other hand, is cut off from us by the barrier of a language which few can read, and the remarkable soil work which was going on in Russia and has now produced such a great change and widening of the views of soil investigators throughout the world, was unknown in Great Britain until after the Great War, when it began to filter through to us from America, Germany and other countries.

What are these fresh views which we all sat at the feet of the Russians to learn? They treat the soil as an independent natural object worthy of study for its own sake and not merely as a useful medium in which to grow crops, or as a subsidiary branch of geology or chemistry or any other science. The branch of science which deals with soils they treat as an independent branch, which they call pedology. Many people in Great Britain and in America have now adopted this term and prefer to be pedologists—a word not in the dictionary—rather than soil scientists. My own preference is for a term which is readily understood by ordinary people.

Next, the Russians insist that the soil is the natural product of a number of soil-forming factors of which the most important is climate, and that its nature is not determined by its geological origin. Their great primary classification of soils is into a number of climatic zones. The most notable feature in the whole Russian philosophy of soils is the insistence on the importance

* From the presidential address to Section M (Agriculture) of the British Association, delivered at Blackpool on September 14.

of climate as a soil-forming factor. Climate plays the central part in their system of soil classification. This recognition of climate is not entirely a new idea. Hilgard in America, and others, had already shown that climate has a great effect on the nature and composition of soils.

In the old Russian Empire, and the modern union of Soviets, there are soils which have been produced in a great variety of climates in Russian Europe and Asia. The Russian soil workers set themselves to collect these and to examine them critically, and came to the conclusion that soils produced from a geological formation in a cool climate were very different from those produced from the same geological formation in a hot climate, and that those produced in a moist climate were very different from those produced from the same parent materials in an arid climate. In fact they showed that soils cannot be classified and characterized on a geological basis. Possibly some of them, and still more some of their enthusiastic converts in other lands, go too far in excluding geological origin altogether as a factor in soil formation.

The next great feature of the Russian system is the classification of soils according to what is found in the soil profile. The profile, as is now well known to all of us, though that was not so twenty years ago, is a section of the soil from the surface down to the parent material. If such a section is examined, it is almost invariably found to consist of a number of different layers, called horizons, which are generally easily distinguishable from one another. When a great many such profiles are examined from different parts of the world it is found that they fall into a number of definite types characteristic of the different types of soil. The profile is an expression of the results of the different soil-forming factors, and therefore characterizes the different types of soils as produced by the action of these factors. This is expressed by saying that the profile is the resultant of the pedogenic processes. The modern soil surveyor studies morphology of soil profiles and classifies his soils accordingly.

This is in outline very simple; in practice it is often very difficult, and is apt to give rise to differences of opinion, especially when those accustomed to the profiles of one part of the world are introduced to a new region with conditions different from those to which they are accustomed. It will be seen, too, that this scheme of a profile made up of horizons is a development of the old division of the soil into soil and subsoil. But there is an important difference; the terms soil and subsoil were applied to cultivated soils mainly, and the soil was, generally speaking, the layer which had been mixed and influenced by the implements and processes of cultivation, while the subsoil was the layer which was not touched by instruments of cultivation. Such a division is of no use to the modern student of soil morphology and genetics. The processes of cultivation have turned over and mixed the surface layers and have also modified those below the region reached by the plough. The modern soil investigator, therefore, insists that the profile must be studied in undisturbed soil which has existed in its natural condition for a long period of time. To him the profile is the soil unit which must be studied as a whole, unmodified by artificial operations of man. This of course introduces difficulties in old settled countries of dense population, like our own, where most of the soils which are worth cultivation have been broken up and cultivated at one time or another. In the extensive, lightly populated areas of Russia or North America there are plenty of natural soils; but in applying modern methods of soil study to the soils of much of western and southern Europe and other regions of ancient civilization, modifications have to be introduced to allow for the influence of cultivation which, in many cases, extends over long periods of time.

The whole of the processes of soil formation are very complex and require much more study before we can hope to reach, I will not say a final, but a sound system of soil classification. The soil itself is, from every point of view, a very complex and variable material; and our present methods for its study and classification, though a great advance on what went before, are of very recent origin, and no doubt further great progress will be made as a result of the intensive studies to which soils are now being subjected in many lands.

In the above sketch I have merely referred to one or two features of the Russian soil philosophy which appear to me to be outstanding. Much of the Russian soil science is at present remote from agricultural practice. It is curious that in spite of their theories of Government and of five-year plans for the rapid practical improvement of the condition of the people, the Russians are the champions of pure soil science, of the view that our study of soils should proceed without reference to any use that may be made of such knowledge for the service of agricultural practice, or for the production of wealth from the soil.

The fundamental importance of soil moisture has been known for ages. Without water, crops cannot grow, and with excess of moisture we get marsh or swamp and our ordinary crops are drowned out. A proper supply of moisture is more important to crops than all the fertilizers put together. In the modern theory of soil formation and classification the important part played by water is recognized. The two important factors

in climate, those which do most to determine what the soil is to be, are the supply of water and the temperature. In considering water supply it is not sufficient to consider the rainfall—the humidity, the distribution of the rainfall and the topography all enter into the picture. A rainfall which is sufficient to wash through the soil and leach away soluble constituents in a cool humid climate may all be re-evaporated and leave nothing to wash through the soil in a warm climate with a dry atmosphere. Again, if all the rain falls at one season of the year a part of it may seep through the soil and escape as drainage water, while if the same rainfall is distributed throughout the year so much may be re-evaporated that there will be none to escape as drainage.

Considering the importance in soil formation of water which passes through the soil, and of the amount and nature of materials in solution and suspension which are washed away by such water, or removed by it to lower layers of the soil, and the importance to soil fertility of the relations of the soil to water, and of the economic importance of drainage in connexion with the loss of nitrogen, lime and other manurial constituents from the soil, it has always been a matter of surprise to me that more use is not made in soil studies of drain gauges or lysimeters, or instruments of a similar kind.

The first drain gauges, so far as I am aware, were made by Lawes and Gilbert at Rothamsted more than sixty years ago. They were designed to study evaporation and percolation in relation to depth of drainage, and were therefore of different depths, 20, 40 and 60 inches respectively. They were also used to study the amount of nitrogen washed away from uncropped and unmanured soil. The blocks of soil enclosed in these drain gauges were never broken up, they were built with as little disturbance as possible into the water-tight structures which enable the drainage to be measured. They consist therefore of real soils which have been formed by a long course of natural soil-forming processes. Similarly the drain gauges which I have had built at Craibstone, near Aberdeen, have been formed by enclosing, without disturbance, in water-tight boxes of Caithness slate, blocks of natural soil which have never been broken up. My drain gauges are intended to study the changes which take place in cultivated soil, and the losses which take place in the drainage water during ordinary processes of cropping and manuring.

Such drain gauges are not easy to construct. I suppose that is why this method has been so little used in the study of soils. It is much easier, and cheaper, to build a water-tight box and fill subsoil and soil into it, than it is to enclose a block of natural soil, weighing several tons, in a water-tight structure. If the easier method is adopted, as has been done to a large extent in America and elsewhere, its limitations must be recognized. The soil, once it is broken up and filled into a lysimeter, is no longer a natural soil, and it is difficult to say how long it will take under the influence of the soil-forming processes of the locality to become once more a real soil such as is provided in Nature.

The development of our knowledge of soil colloids and base exchange during the present century is second in importance only to the advance which has been made in the science of soil formation, structure and distribution. The beginnings of our knowledge of this subject can be traced back to the middle of last century when Way showed that the ammonium of ammonium sulphate, or the potassium of potassium sulphate, was retained by the soil while an equivalent amount of calcium went into solution and could be washed away as sulphate. He also showed that this power resided in the finest mineral part of the soil, the clay, and he regarded the action as an ordinary case of double decomposition between clay and the soluble, neutral salt in solution.

Though there was much discussion about these phenomena, which were regarded as of the greatest practical importance because they showed that valuable manurial bases when applied in a soluble form could be absorbed and retained in the soil, and though soil investigators of last century were divided into two camps, one regarding this fixation of bases as a chemical precipitation by double decomposition and the other looking upon it as a physical process of absorption, little further advance was made until the present century. By that time, considerable advance had been made in our knowledge of colloid chemistry, and we also knew that there were two types of colloid complexes found in soils, one mineral and the other organic.

We now know that this process of base exchange is a colloid phenomenon, and follows the laws of colloid chemistry. It is not confined, as Way supposed, to the fine mineral matter of the soil, but is a property of the organic colloids also. The old controversy as to whether this is a chemical or a physical phenomenon is thus cleared up and both sides are shown to be right or both wrong, according to taste, for both sides knew nothing of that border-line field of colloid phenomena where physics and chemistry blend, and, in the best modern manner, tend to become indistinguishable.

Our knowledge of the chemistry of humus, in spite of the great amount of work which has been done upon it in recent years by workers in many countries, is still in a state of doubt and darkness, but in the last few years we have learned a great deal about the chemical structure of clay. The application of X-ray methods of analysis has shown

that much clay material exhibits a definite lattice structure, and that there are several different minerals, showing at least two different types of lattice structure, to be found in clays. Some light has also been thrown by this work on the nature of the base exchange capacity of clay and on the great differences in base exchange capacity which are found in different types of clay substances.

One cannot give a very hopeful account of the progress of our knowledge of humus. We have not yet found any clear method of unravelling its structure and of showing what is the nature of the colloid molecules which build up the main part of this very important soil constituent.

In many other directions, fundamental soil science has made in this century, and is making, marked advances. Fertilizers, for example, we may class along with the soil, for they are substances used to increase the productivity or make up the deficiencies of the soil. From small beginnings a century ago, the fertilizer industry has grown to be one of the world's greatest chemical industries. In the early days of the industry Great Britain played a notable part, but in the latter part of last century and the early part of this one, when the whole of our soil science was in a somewhat backward position, our fertilizer industry also fell into the background. We have recently seen a great revival consequent upon this industry again becoming scientific instead of depending merely upon commercial and business ability. For this change and improvement we may, I think, give much of the credit to Imperial Chemical Industries, Ltd., who are now our greatest fertilizer manufacturers, and who make the manufacture of manures an important section of their business. The older type of fertilizer manufacturers may have employed a few works analysts, but they did not pay for the best scientific brains to help them to introduce new processes and to improve old ones. That has been changed by I.C.I., and we have a new spirit in the fertilizer industry and we are regaining something of the great position we once held in that important branch of chemical manufacture. It is to be hoped that this will continue. If we are not to fall back into the old state of lethargy we must continue with long-range research, as the Germans and Americans are doing, carried out by educated and competent persons. That is the only way if we are to continue to advance and keep in the front.

Physics is not the only branch of science in which revolutionary changes have been made in the twentieth century. Even in soil science we have seen a structure built up which the agricultural chemists of a generation ago would find strange. In the British Isles at the beginning of the century there was almost no soil science ; now we are taking our due part in building up and nurturing this branch of knowledge. We have now not only the great station at Rothamsted but also the Macaulay Institute at Aberdeen, which is engaged in the study of soils of different types from those of the south-east of England and is approaching soil study from a somewhat different angle. There are also in our universities and agricultural colleges quite a number of soil investigators of distinction who are dealing with the soils of many other parts of the country. At the same time, it is probably true to say that in Britain the fundamental attitude towards soil study remains the same. It is difficult for us to achieve the complete detachment of the Russians and study soils entirely apart from any practical agricultural applications which our studies may have.

But to what are we heading ? Of what use is it all ? Are we only increasing sorrow by increasing knowledge ? Our increased knowledge should give us increased power to use the soil, and that surely means increased production. We are told there is already over-production and that what is required is restriction of production. We read in our papers of crops being destroyed because they cannot be used, or because it does not pay to harvest them. In the United States, and elsewhere, the growth of fundamental food crops, like wheat, has been restricted. In Great Britain arable land is decreasing while at the same time the import of foodstuffs is being restricted.

Has everybody in this country, and in every other country, too much, or even enough, food ? Do we not, at the same time as we are crying out about over-production, hear an equal outcry about malnutrition and under-feeding even in this comparatively prosperous country ? The two things do not fit together. They cry out against one another. They cannot both be right. But we all know that there are many people, forming quite a large section of the population, who have not over-abundance, who have not even enough. This, which is true of Great Britain, is, unless we are strangely misinformed, true in a much higher degree of the world at large. This is not a problem of soil science, but a problem for the statesman, the social reformer and the economist. The soil scientist can safely go on and increase our knowledge of soils, and hope that, in the long run, it will increase production and lessen labour. Increased wealth, especially in the essential things produced from the soil, is a blessing, not a curse, and if it can be obtained more easily, and more certainly, through the power and control provided by increased knowledge, that is all to the good.

The solution of our difficulties must be looked for by the increase of impartial scientific knowledge in other directions. It is our social organization,

our statesmanship, our economic system which are at fault when the abundance which is produced cannot be brought to the many who are in need of it. Social and political sciences and even economic science are no doubt applying themselves to this problem, and let us hope they will be able to remove it from an atmosphere of social prejudice and party bias to the calm, truth-seeking atmosphere of pure scientific investigation. Agricultural science can go forward fearlessly to increase knowledge in the good hope and belief that increased knowledge will be in itself a blessing.

Cancer Research in Great Britain

THE thirteenth annual report of the British Empire Cancer Campaign was presented at a meeting held at the House of Lords on November 23. The report gives an effective summary compiled by institutions and individuals of the greater part of British research on malignant disease. The field of cancer research may be divided into three parts : the origin of the disease ; the nature of malignant growths ; and the effect of treatment in alleviating or curing the disease. Investigations in man, in animals and in cells growing outside the body in tissue culture have been made in all three directions during the last year.

Attempts to understand the nature of the processes which cause cancer in man have been made by studying cancer mortality according to the organ in which it occurs in different districts and different occupations. Observations of this kind have in the past indicated that coal tar and certain lubricating oils might be carcinogenic and so lead eventually to the isolation of the pure carcinogenic compound, benzpyrene. Previous investigation into the mortality from cancer in different countries has shown surprising differences, such as the high incidence of liver cancer in the East and its comparative rarity in Europe. In Switzerland, cancer of the œsophagus is more frequent than in the rest of Europe. Dr. Stocks, of the General Register Office, has examined the geographical distribution of 522,251 deaths occurring between 1921 and 1930 from cancer in the counties of England and Wales. He has calculated the "actual mortality per cent of that expected from the distribution of population by age and class of district". The results are depicted in a series of maps. Some of the more outstanding differences are shown in the accompanying table.

Death from cancer of all sites is more common than would be expected in North Wales and unexpectedly rare in Radnor and East Suffolk. In Wales, gastric cancer is frequent, and Carnarvonshire accounts for more than twice the expected number of deaths, but lung cancer is rather infrequent. The results show resemblances between the distribution of œsophageal cancer and rectal cancer, while the distribution of gastric cancer is quite different. The distribution of the ratios for breast cancer is much more uniform than for any other type of cancer shown. It is as yet impossible to determine whether these differences are due to genetical factors, to geological or meteorological conditions, to the different diets and habits of people, or to the difference in accuracy of diagnosis.

Prof. E. L. and Mrs. Kennaway have computed the incidence of death from cancer of the lung and larynx in a large number of occupations, for the years 1921–32. During the period 1919–34 there was an eight-fold increase in the mortality from lung cancer. The cause of this increase has not been identified, but it does not appear to be due to urbanization as the relative increase among agricultural workers is only slightly less than among the total population. Workers exposed to coal gas and tar and those engaged in tobacco and metal grinding trades show high susceptibility, while coal miners, cotton spinners and agricultural workers have a low susceptibility to lung cancer. This latter finding is reflected in one of Dr. Stocks's maps. Mortality from cancer of the lung is less

DEVIATION OF ACTUAL MORTALITY FROM THAT EXPECTED FROM THE DISTRIBUTION OF POPULATION BY AGE AND CLASS OF DISTRICT.

	High Incidence	Low Incidence
All sites (males)	Flint, London, Huntingdon.	East Suffolk, Radnor.
All sites (females)	Anglesey, Merioneth.	Radnor.
Stomach (males)	Ely, Anglesey, Carnarvon, Denbigh, Merioneth, Montgomery, Pembroke.	East Suffolk.
Stomach (females)	Anglesey, Carnarvon, Denbigh, Merioneth, Pembroke.	West Sussex.
Œsophagus (males)	Berkshire.	Durham, Lincoln (Holland and Lindsey), Northumberland, Nottingham, Merioneth, Monmouth.
Skin (males)	Lincoln (Holland), Anglesey, Cardigan.	Gloucester, Carnarvon, Radnor.
Lung (males)	Hertford, London, Middlesex, Essex, Nottingham.	Berkshire, Cumberland, Devon, Dorset, Durham, Gloucester, Lincoln (Holland), Northampton, Suffolk, all Wales except Flint.

than would be expected in agricultural areas and in the mining areas of South Wales, Cumberland and Durham.

Results obtained in studying the effect of X-rays and radium on malignant growths are reported from many centres in Great Britain, Australia and Canada. In treatment there has been a tendency to utilize deep X-ray therapy for lesions in which radium has previously been usually employed. An interesting development of X-ray technique is the use of the low-voltage (60,000 volt) tube advocated by Prof. H. Chaoul of Berlin. With this instrument the actual source of the X-rays can be placed within a few millimetres of the tissues. It is as yet too early to compare this with the older methods, but it should be advantageous in certain cases. The comparison of results obtained by different methods of therapy will be simplified by the adoption of a standard method of recording cancer cases in different hospitals. The value of such standard records is enhanced now that it is realized that accurate dosage is important for successful treatment. It is essential to protect the operators from stray radiation, and workers in some centres carry small charged condensers ; the amount of discharge occurring in the condenser gives a measure of the radiation and acts as a warning or tell-tale to the therapist.

X-rays and radium are both able to produce tumours and also to destroy them. Dr. A. Haddow has found that several chemical agents which produce cancer when applied to animals also inhibit the growth of tumours. The inhibition appears to some extent specific for carcinogenic agents, although feebly-carcinogenic and non-carcinogenic compounds are sometimes inhibitory. Many non-carcinogenic compounds have no growth-inhibiting effect. Not only tumour growth but also body growth is decreased by treatment with carcinogenic hydrocarbons, and it is suggested that the carcinogenic action is the result of a restraining action rather than stimulating action on cell growth. The movement of the fluorescent carcinogenic hydrocarbons in the body has been observed in a darkened room under ultra-violet illumination by Dr. P. R. Peacock. He finds that colloidal particles of hydrocarbons are rapidly removed from the blood stream by the liver and then excreted into the intestine, dissolved in bile. It is possible that the compounds are reabsorbed from the intestine into the blood stream.

The first known pure carcinogenic compound was 1 : 2 : 5 : 6-dibenzanthracene, and it is interesting to see how its molecular structure can be modified without destroying the biological activity, as shown by further work at the Royal Cancer Hospital. 1 : 2 : 5 : 6-dibenzfluorene, in which the 6-membered central ring is replaced by a 5-membered ring, is carcinogenic. 1 : 2 : 5 : 6-dibenzacridine and 3 : 4 : 5 : 6-dibenzacridine, in which one of the central carbon atoms of the original compound is replaced by nitrogen, are carcinogenic. While 1 : 2 : 5 : 6-dibenzanthracene is much more active than the 1 : 2 : 7 : 8- (or 3 : 4 : 5 : 6-) compound, 3 : 4 : 5 : 6-dibenzacridine is much more active than 1 : 2 : 5 : 6-dibenzacridine. If two carbon atoms are replaced by nitrogen as in 1 : 2 : 5 : 6-dibenzphenazine the activity disappears. Other new carcinogenic compounds are 1 : 2 : 5 : 6-dibenzcarbazole and 3 : 4 : 5 : 6-dibenzcarbazole, which may be considered as dibenzfluorene compounds with one nitrogen in place of one central carbon atom. These compounds resemble the acridine derivatives in that greater activity is associated with the 3 : 4 : 5 : 6-configuration. Painting of mice with 3 : 4 : 5 : 6-dibenzcarbazole produces epitheliomata on the skin and proliferation of the bile ducts, and nodules resembling hepatoma in the liver.

Some derivatives of 1 : 2 : 5 : 6-dibenzanthracene have considerable œstrogenic activity. Profs. Cook and Dodds and Dr. Lawson have shown that 9 : 10-dihydroxy-9 : 10-di-*n*-propyl-9 : 10-dihydro-1 : 2 : 5 : 6-dibenzanthracene can fully reproduce almost all the biological effects that are known to be produced by the natural hormone œstrone. New compounds have now been tested which have œstrogenic activity but do not contain the phenanthrene nucleus. The most active of these new substances appears to be 1 : 2-dihydroxy-1 : 2-di-α-naphthylacenaphthene and the simplest compound known to have œstrogenic activity is 4 : 4′-dihydroxy diphenyl.

Further work on the relation of ovarian hormones to cancer is reported. Mr. Burrows obtained mammary tumours in castrated male mice which were painted with a benzene solution of œstrone. Dr. Bonser has compared the reaction of male mice of two pure strains to painting with œstrone. In one agouti strain, in which spontaneous mammary cancer never occurs, there was widespread generalized growth with production of acini but no production of mammary cancer. In an albino strain, the females of which often develop mammary cancer, the males treated with œstrone showed a more localized acinar development, and this was associated with the development of mammary carcinoma. The results show how reaction to œstrone is dependent on the ancestry of the animals used, and also how the two factors, heredity and environment, are concerned in the origin of malignant disease. There is little doubt that when we can fully account for the distribution of human cancer in terms of these factors, we shall be near to the solution of the problem of the prevention of the disease.

The Observational Approach to Cosmology

SINCE its first announcement by Dr. E. P. Hubble in 1929, the existence of a linear relation between 'velocity' and distance among the extra-galactic nebulæ has excited a great deal of theoretical interest, the more so since it appeared to be a direct confirmation of the instability of the Einstein universe predicted by Lemaître. It was therefore not unfitting that the discoverer of the relation, himself a Rhodes scholar, should have been invited to deliver the Rhodes Memorial Lectures in Oxford on October 29 and November 12 and 26, or that he should have used this opportunity to present the observer's interpretation of the wealth of material since accumulated on this problem by himself. The lectures, which dealt in turn with the observable region, the role of the red-shifts, and possible models of the universe, have revealed that a static universe with a hitherto unsuspected dependence of light frequency on distance is probably more acceptable than one or other of the homogeneous expanding models of general relativity.

This startling conclusion depends in a very large measure on the 'luminosity' methods of distance determination necessarily used for the extra-galactic nebulæ. The intrinsic luminosity of the average extra galactic nebula having been determined by means of the Cepheid variables found in nebulæ of the 'local group', the distance of any nebula can be found from its apparent luminosity and the inverse square law. The apparent luminosity is, however, affected by the observed redward displacement of the spectrum. Assuming that the energy distribution in the spectrum of an extra-galactic nebula is similar to that of the sun, as is very nearly the case, and correcting for atmospheric absorption, reflectivity of the telescope and plate sensitivity, one can find empirically the correction, $\triangle m_1$, to be applied to the apparent photographic magnitude for any desired red-shift; with sufficient accuracy this correction is given by $\triangle m_1 = 3 \triangle \lambda/\lambda$. If, however, the nebulæ are actually receding from us, an energy correction alone will not suffice, but in addition a correction must be made for the fact that we receive fewer quanta per second from a receding nebula than from a stationary one. This correction amounts to $\triangle m_2 = \triangle \lambda/\lambda$. Clearly the apparent luminosity to be used in finding the distance of the nebula from its intrinsic luminosity and the inverse square law will depend upon whether the nebula is receding or not, and if there were only some independent means of distance determination the presence or absence of recession could be immediately inferred. Even in the absence of an independent method of distance determination, it is still possible to make some progress in distinguishing between recession and non-recession by counts of nebulæ.

If the total number of nebulæ, or the number of nebulæ per square degree, are counted to different limiting apparent magnitudes, and these limiting magnitudes after the appropriate corrections for recession or non-recession converted to distances, the nebular counts will yield immediately the spatial distribution of nebulæ as a function of distance. In his recent lectures, Hubble used five nebular counts to limiting apparent magnitudes 18·5, 19·0, 19·4, 20·0 and 21·0, the second of these counts having been made by Mayall with the 36-in. Crossley, the remainder by Hubble with the 60-in. and the 100-in.; the last count, it is interesting to note, is within half a magnitude of the limit set for the 100-in. by scattered sky light. Correcting these limiting magnitudes for energy effect alone (no recession), the five counts are perfectly represented by the relation

$$\log N(m) = 0{\cdot}6\ (m - \triangle m_1) + \text{constant}.$$

This linear relation is precisely that which would hold if the spatial distribution of the nebulæ were uniform out to the limit of the counts, that is, to a distance of some five hundred million light years. We can interpret this result to mean that we are seeing only a portion of a much larger universe, a portion within which the spatial distribution of nebulæ is uniform, and a universe in which the frequency of a light quantum varies linearly with the distance. Without in any way straining the observations, but at the expense of a newly postulated property of radiation, we can describe the nebular counts in terms of a simple static universe.

If, on the other hand, the limiting magnitudes of the nebular counts are corrected for recession as well as for energy, the resulting apparent spatial distribution is one centrally symmetrical about the galactic system with necessarily increasing spatial density outwards. Since our galactic system appears to be closely similar in intrinsic luminosity and mass to the nebulæ whose density distribution we are discussing, there is no reason why the galactic system should occupy so dominant a position in the universe, and we must regard this spatial distribution, found when we assume the nebulæ to be receding, as only apparent. On

Milne's original kinematic model of the universe, this outward increase in density is just what would be expected from the fact that we do not have, as it were, an instantaneous view of the universe, but are seeing the more distant nebulæ as they were some five hundred million years ago. When the observed density distribution is corrected to the instantaneous view, the resulting spatial distribution turns out to be uniform; since on the kinematic model, however, uniform density distribution can only occur once, Hubble finds it nearly as unsatisfactory to suppose that we are just happening to observe the universe at a special instant in time, as if we were observing from a specially favoured point in space.

Still assuming that the observed red displacement is due to a velocity of recession, and that therefore the apparent spatial distribution of nebulæ increases radially outwards, Hubble next examined the apparent distribution of nebulæ predicted by the homogeneous expanding models of general relativity, a special case of which also includes in many of its aspects Milne's kinematic model. Tolman has shown that the nebular counts predicted by these models take the form

$$\log N(m) = 0{\cdot}6\,\{m - \triangle m_1 - \triangle m_2 + F(R)\}$$

where R is the radius of space curvature. At the very outset an almost insuperable difficulty is encountered in that the observed counts do not obey a relation of this form. If, however, it be assumed that the observed counts are subject to almost impossibly large systematic errors, the relation and the observations may be used to calculate a value of R. The resulting value is of the order of five hundred million light years, rather less than the penetrating power of the 100-in. telescope, and since there is a relation between R and the density of matter in space, the density must be 10^{-26} gm. cm.$^{-3}$, which is many times greater than the mean density produced by the nebulæ alone. To account for this density we must postulate that inter-nebular space is filled with matter the mass of which is greatly in excess of the total mass of the nebulæ, and which is distributed in such a form as to produce no absorption of light in space, since any absorption would demand a still smaller radius of curvature and larger mean density.

If no recession is assumed, the observed nebular counts are satisfactorily described by supposing that we are observing a finite portion of a much larger universe of nebulæ, but a universe in which the frequency of light varies uniformly with the distance. If, on the other hand, recession is assumed, the observed nebular counts are not satisfactorily described by any of the homogeneous expanding models of general relativity, but if forced to fit require that the universe be closed, that we have already explored it to its outmost bounds with the 100-in. telescope, and that it is a universe dominantly filled with non-luminous matter distributed in such a way as to absorb or scatter negligibly small amounts of light.

The large and appreciative audiences who followed the three lectures, each a model of exposition and clarity, had little difficulty in agreeing with Dr. Hubble that the consequences of assuming no recession were the less difficult to accept. H. H. P.

News and Views

Prof. A. N. Talbot

PROF. ARTHUR N. TALBOT, emeritus professor of engineering in the University of Illinois, has been awarded the John Fritz Gold Medal, the highest of American engineering honours. Prof. Talbot, who is seventy-nine years of age, was cited as "moulder of men, eminent consultant on engineering projects, leader of research, and outstanding educator in civil engineering". The award is made annually by a board composed of sixteen past-presidents of the four national societies of civil, mining and metallurgical, mechanical and electrical engineers. Prof. Talbot was born in Cortland, Ill., on October 21, 1857. He has been engaged in engineering work since 1881, his activities embracing railroads, roads, bridges, buildings and municipal public works. Prof. Talbot aided in the development of the testing laboratories and the College of Engineering of the University of Illinois. He has been active in the formation and development of the Illinois Engineering Experiment Station, in connexion with which he has made numerous investigations in the properties of steel, brick, concrete and reinforced concrete, and in water purification, sewage treatment and hydraulics. Among previous recipients of the John Fritz Gold Medal have been Lord Kelvin, Thomas Edison, Guglielmo Marconi, Elihu Thomson and Sir Robert Hadfield.

Sir Robert Mond

SIR ROBERT MOND has been elected an associate foreign member of the Académie des Inscriptions et Belles Lettres in Paris, in succession to the late King Fuad of Egypt. Sir Robert Mond's wide interests are illustrated by the fact that he is honorary secretary of the Davy Faraday Research Laboratory at the

Royal Institution, chairman of the Norman Lockyer Observatory Corporation, and also president of the Egypt Exploration Society; he is a Messel medallist of the Society of Chemical Industry, a past president of the French Society of Chemical Industry, and he has carried out noteworthy archæological excavations at Thebes, in Palestine, and in Brittany. The museum at St. Germain has been much enriched as a result of his excavations in Brittany. The Académie des Inscriptions, by its election of Sir Robert as a foreign associate member, has attracted to its service one whose knowledge in many fields can scarcely fail to promote its activities and influence.

Prof. A. F. Burstall

DR. AUBREY F. BURSTALL has been elected professor of engineering and dean of the faculty of engineering in the University of Melbourne, Australia. Dr. Burstall is a son of the late Prof. F. W. Burstall, who was professor of mechanical engineering in the University of Birmingham in 1896–1931. Dr. Burstall, who is thirty-four years of age, received his education at King Edward's School (New Street), Birmingham, at the University of Birmingham and at St. John's College, Cambridge. The results of his work on the combustion of various gaseous fuels in the high-speed internal combustion engine were published in a series of papers before the Institution of Automobile Engineers. Dr. Burstall joined in 1925 the staff of Synthetic Ammonia and Nitrates Ltd. at Billingham, which in 1928 became a constituent company of Imperial Chemical Industries Ltd. He held various positions of increasing responsibility on the engineering staff and in 1930 was appointed deputy chief engineer of the Billingham Factory. In 1933 he resigned his position to become technical adviser to the Aluminium Plant and Vessel Company of Wandsworth, London. The Engineering School at the University of Melbourne, to which Dr. Burstall is going, is one of the largest in Australia, the students numbering nearly two hundred. During the last two years of the four year course the undergraduates specialize in either civil, mechanical, mining, electrical or metallurgical engineering before taking their degrees. Dr. Burstall succeeds Prof. Wilfrid Kernot, who is retiring in March at the end of the present academic year.

Ernst von Bergmann

ERNST VON BERGMANN, who was one of the most skilful surgeons and commanding personalities in Germany of the last century, was born at Riga on December 16, 1836. He received his medical education at Dorpat, Vienna and Berlin and qualified on November 13, 1860. He commenced his career as assistant in the Dorpat surgical clinic and afterwards served as a medical officer in the Prussian Army in the war with Austria in 1866 and in the Franco-Prussian war in 1870. He was elected professor of surgery at Dorpat in 1871. In 1877, when war broke out between Turkey and Russia, he became consulting surgeon to the Russian Army invading Rumania, and in the treatment of wounds carried out the antiseptic method just introduced by Lister. His activities as a military surgeon, however, were cut short by a severe attack of dysentery, and in 1878 he was appointed professor of surgery and senior surgeon to the Julius Hospital at Würzburg. He remained there until 1882, when he succeeded Langenbeck in the chair of surgery at Berlin. In 1887 he attended the Emperor Frederick in his last illness, when an unfortunate dispute as to the correct diagnosis and treatment arose between the German surgeon and Morell Mackenzie, the well-known London laryngologist and author of "Frederick the Noble".

VON BERGMANN is best known for his introduction of aseptic surgery, the principles and practice of which he described at the Tenth International Medical Congress held at Berlin in 1890 in conjunction with his assistant C. S. Schimmelbusch, whose work on the subject is a surgical classic. Von Bergmann also made a valuable contribution to the literature of military surgery by his works on injuries to the head and brain and gunshot wounds of the knee-joint. In association with Profs. von Bruns of Tübingen and Mikulicz of Breslau, he edited a handbook of practical surgery, of which the first edition appeared in 1900. He took an active part in the promotion of post-graduate study and was the founder and moving spirit of the Berlin ambulance organization. He was the recipient of many honours both in Germany, where he was given the title of Excellency and made a member of the Prussian House of Lords, and in other countries including England, where he was elected in 1900 an honorary fellow of the Royal College of Surgeons. He died at the age of seventy years on March 25, 1907, and was succeeded in the chair of surgery at Berlin by Prof. August Bier, who celebrated his seventy-fifth birthday on November 24.

Alexander Neckham (1157-1227)

IN his Friday evening discourse at the Royal Institution on December 4, Sir Stephen Gaselee discussed "Natural Science in England at the End of the Twelfth Century". It was impossible to survey all the English writers who were treating of natural science about A.D. 1200, but there is fortunately one who was widely read and a good compiler, and at the same time a personal observer of Nature—Alexander Neckham, born in 1157. He was born at St. Albans; afterwards he was headmaster of a school at Dunstable, and also studied in Paris. He later joined the Augustinian Canons at Cirencester, where he spent the rest of his life, becoming their abbot in due course, and died about 1227. He was an author of many and various works: one is called "Of the Natures of Things", and is partly a compilation from Pliny, Solinus and Cassiodorus; but is not without evidence of his own personal investigations. There is continuous moralizing throughout the book; but in natural science he begins with a description of the firmament, the sun, moon and stars; then the four elements; and then starts a survey of the animal world, beginning with

birds. He intersperses his scientific descriptions with anecdotes, sometimes amusing, as of those of the hawk and the eagle, the parrot, and the wren. Turning to fishes, he first refers to some of the physical properties of water and then describes the inhabitants of the deep with a story about the plaice: fishes finished, he describes minerals, with an interesting account of the properties of the loadstone, and vegetables: and then the animal kingdom, with amusing stories about weasels, monkeys and lions: and finally comes to the 'lord of creation', man; after a talk of light and mirrors, he describes the purports of the farm-yard and the dwelling house, with an interesting discussion on silk-worms, and incidentally mentions education and the universities of his day.

British Association: Officers for 1937

THE annual meeting of the British Association will be held next year in Nottingham on September 1–8 under the presidency of Sir Edward Poulton. The following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Dr. G. W. C. Kaye; B (Chemistry), Dr. F. L. Pyman; C (Geology), Prof. L. J. Wills; D (Zoology), Prof. F. A. E. Crew; E (Geography), Prof. C. B. Fawcett; F (Economics), Prof. P. Sargant Florence; G (Engineering), Sir Alexander Gibb; H (Anthropology), Dr. J. H. Hutton; I (Physiology), Dr. E. P. Poulton; J (Psychology), Dr. Mary Collins; K (Botany), Prof. E. J. Salisbury; L (Education), Mr. H. G. Wells; M (Agriculture), Mr. J. M. Caie.

Peking Man: Further Discoveries

RECENT excavation in the cave of Choukoutien, the home of Peking man, has proved fortunate beyond all expectation. No less than three new skulls of *Sinanthropus* have been added to the relics of this primitive type of early man. On October 22, Mr. L. P. Chia, of the National Geological Survey of China, brought to light a left mandible with teeth pronounced to be male in type, to which Sir Grafton Elliot Smith refers in a letter to *The Times* of December 5. This was followed by the discovery by the same excavator of two skulls (*The Times*, Nov. 20) and to this in turn has succeeded a further discovery of another skull, which, if the description given in the dispatch from the Peiping correspondent of *The Times* of December 8 be accepted as accurate, may well prove of even greater significance than the earlier finds of new material. With the two skulls previously known, of which the first was found by Mr. W. C. Pei in December 1929, there are now five skulls of *Sinanthropus pekinensis* in existence, while a sixth has been reconstructed from fragmentary finds by Prof. Franz Weidenreich, the director of the Cænozoic Research Laboratory of the Geological Survey. The new material is of outstanding importance in view of the fact that the skulls are those of fully developed adults, whereas the two skulls previously known were those of adolescents. Of the skulls recently discovered, the first two are of a male and a female, in age between forty and fifty years. Added evidential value attaches to the third skull owing to the fact that it is in a more complete state of preservation than any previous specimen. Certain parts of the base of the skull missing in the other skulls are here present, as well as parts of the facial skeleton and nasal structure.

Significance of Peking Man

THE relics of Peking man available for study at the Peiping Union Medical College, together with the new skulls, represent twenty-four individuals, and include twelve lower jaws and nearly one hundred teeth. They fully justify the description of them by Prof. Weidenreich as the "richest and most complete collection of human fossils ever recorded, unique in every respect" (*The Times*, Nov. 25). Since Prof. Weidenreich's appointment to the Rockefeller Institute, constituting him Director of the Cænozoic Research Laboratory in succession to the late Dr. Davidson Black—an appointment made on the recommendation of Sir Grafton Elliot Smith, as the latter now reveals in his letter to *The Times*, where, however, by a clerical error the name appears as "Weideman"—he has naturally devoted much time and attention to the study of Peking man, and in a recent publication (see NATURE, **173**, 73) has put forward some interesting and suggestive conclusions as to the relation between *Sinanthropus* and Mongolian man, while further important results have accrued from his comparative studies based more particularly on the examination of the endocranial casts (NATURE, Oct. 17, p. 689). With this additional important material at his disposal, illuminating studies may be anticipated. While it is too early, and too little information is available, to attempt any forecast of the direction in which results are likely to tend, it is interesting to note that it is stated that the female skull has many similarities to *Pithecanthropus*, while the male skull is much higher and nearer Neanderthal man. Further, Prof. Weidenreich is reported to have said that the various specimens of Peking man form links between *Pithecanthropus* and Neanderthal man. Sir Grafton Elliot Smith's letter to *The Times*, relying on information supplied by Mr. W. C. Pei, now superseded, expresses some anxiety as to the future of these investigations. Clearly, in view of the importance of the material now awaiting examination, any serious interruption or even break in continuity would be a catastrophe.

British Launderers' Research Association

EXTENSIONS to the laboratories of the British Launderers' Research Association were opened by Sir William Bragg on December 1. Mr. W. H. Markham, chairman of the Association, mentioned, in his introductory remarks, that the recent extension of the basis of membership of the Association has met with a good response from the industry, and also that, with an increase of the maximum grant received from the Department of Scientific and Industrial Research, the income of the Association in the coming year will exceed £10,000. The Association,

which was formed in 1921, early commenced a systematic investigation of each section of the laundry process. It instituted methods of measuring colour and observing the efficiency of cleansing on washed articles. Research work now in progress includes studies of the fundamentals of detergency, for example, an investigation of the physical properties of soap and alkaline solutions as well as those of the new detergents known as sulphonated fatty alcohols. Work is also proceeding upon engineering problems which are encountered in laundry machinery. The examination of plant, products and materials, of new and laundered fabrics, is a part of the routine work of the laboratories. In addition, an analytical department undertakes the analysis of products used by the launderers. The information gained is published in the form of reports to members, and a bulletin is issued quarterly in order to inform members of the work in progress, etc. The Association has published three books : "Control of Laundry Operations", "Chemistry of Laundry Materials" and, recently, "Technology of Washing".

Ancient Egyptian Sculpture

MR. C. S. GULBENKIAN'S loan to the British Museum (Bloomsbury) of fourteen pieces of ancient Egyptian sculpture from his collection, for a period of eighteen months, which is now on view in the entrance hall, not only illustrates Egyptian art for a period of 2,000 years from the Middle Kingdom to Ptolemaic times, but it also serves to bring out in a marked degree certain characteristics in which the masterpieces of that art stand out, as against the products of the classical period, and in which it is, in fact, closely akin to the aims of certain schools of modern art. Egyptian art, and more especially Egyptian sculpture, when freed from the conventions imposed by the necessities of formal presentation for State or official purposes, showed a remarkable, and indeed an exceptional, ability to express character and individuality in portraiture. While this is generally admitted in the obvious instance of the Tell el-Amarna school under the influence of Akhnaton, which usually, though not invariably, emphasizes and idealizes a defect, it would seem, in preference to strength, it is equally true of the more robust tradition, which can be traced so far back as the Fourth Dynasty and produced, for example, such well-known specimens as the statuette of Khufu and the effigy of the "Sheikh ed-Beled". That this tradition persisted through a prolonged period can be seen in some of the later exhibits in the British Museum loan collection, such as, for example, the remarkable head of a man in green schist of the sixth century B.C., though possibly many may consider the gem of the collection to be the head in obsidian attributed as a portrait of Amenemhat III to the Twelfth Dynasty, in which the characterization is no less remarkable than the technical skill, which could subdue so refractory a material to its purpose. Another exhibit, in bronze, though of a different genre, attracts attention, and charms by its unusual subject—a cat with two kittens playing.

Sir Robert Hadfield's Gift to Harvard

IN a supplement to the *Engineer* of November 20, there were reproduced photographs of four very striking water-colour drawings depicting war-time work in three departments of Messrs. Hadfields Ltd., of Sheffield. The artist, Mr. Herbert J. Finn, in these drawings, has succeeded in conveying in a remarkable manner the sense of intense activity and vibrant energy of the giant furnaces and myriads of whirling belts of an engineering shop, which may come to be regarded as characteristic of this machine age. Equally vivid, but of totally different character, is Mr. Finn's water colour "Oxford from the Sheldonian Theatre", a pictorial representation of Oxford's spires and domes—a vista breathing the peace and quietude of medieval England. Sir Robert Hadfield has acquired this picture and has presented it to Harvard University in connexion with the occasion of its tercentenary celebrations. Harvard's leading metallurgist, Prof. Albert Sauveur, himself an old friend of Sir Robert, is well known in British engineering circles, for he was the recipient in 1924 of the Bessemer Gold Medal of the Iron and Steel Institute ; on the other hand, Sir Robert is probably equally well known on the west of the Atlantic, for he is a foreign associate of the National Academy of Sciences, he received the John Fritz Gold Medal of the United Engineering Societies of the United States in 1921 and the Elliott-Cresson Gold Medal of the Franklin Institute in 1901. Sir Robert's gift is not only a mark of his own respect and admiration for a great centre of learning in the United States, but also a further link between the universities of Great Britain and the New World, helping to hold them together in the ever-intensifying quest for knowledge.

The Parliamentary Science Committee

THE Council of the British Association resolved, at its meeting on Friday last, that the Association should become a constituent member of the Parliamentary Science Committee, and appointed as its representative Prof. Allan Ferguson, one of the general secretaries of the Association. The arrangement made is subject to revision after three years. The announcement will afford particular pleasure to the members of the British Science Guild, which has now been incorporated with the British Association. The Guild and the Association of Scientific Workers were the parent bodies of the Parliamentary Science Committee, which came into being in October 1933, almost immediately after the presidential address of Sir Frederick Gowland Hopkins at the Leicester meeting of the British Association.

Research Co-ordination Group

AT a meeting on December 2 at River Court, Hammersmith, London, W.6 of the Research Co-ordination Group (see NATURE of February 22, p. 311, and May 30, p. 898) a number of problems dealing mainly with (1) rise in the standard of living and (2) security, were suggested for the attention of scientific investigators. Among these were : the standardization and extension of statistical information, both as

regards production and consumption; nutritional needs and national fitness; population problems and genetics questions; scientific agriculture, afforestation, land reclamation; regional distribution of industry; hydro-electric power, new industrial developments (light metals, carbide and acetylene, plastics, cellulose, synthetic fats); aircraft and poison gas defence; psychology and war; educational use of cinema; vocational outlet for trained workers; and several others. These are to be grouped around the various sciences to which they are related. The chairman (Sir Richard Gregory) referring to the fact that many of these problems have been discussed at recent meetings of the British Association, suggested that the closest co-operation be maintained with the Association, and it was agreed that, if possible, suggestions be made to recorders of suitable sections for the inclusion of such papers in the programme of the next meeting at Nottingham. Material on the above or other suitable topics should be sent to the Honorary Secretary, Research Co-ordination Committee, Hazlitt House, Southampton Buildings, W.C.2 (Telephone, Holborn 1713).

Relativity and the Quantum Theory

In a lecture given before the Newcastle-upon-Tyne Astronomical Society on November 5, Prof. R. A. Sampson discussed "The Spectroscope in the Observatory". Remarking that the spectrum, along with Wilson's cloud chamber and photographs of diffraction patterns due to electrons, furnishes visible records of things that are too small to see, Prof. Sampson pointed out that Dirac holds it is quite impossible to make a rational theory of these things without reconstructing our ideas of the nature of matter altogether. This has led to the two great theories of modern times, namely, relativity and the quantum theory. They are not yet fully reconciled. In his opinion, there are considerable philosophical difficulties in holding either. Relativity, on its merits, may seem a probable theory, but it cannot do its feats without making time an equal co-ordinate with the familiar three of space. Now we cannot think time away, without sacrificing the possibility of expressing ourselves intelligibly to others, and living in a world where history and cause and effect have no meaning. Nor does it upset our own affairs alone; we see the grass grow in summer and die away in winter. That must be an illusion. It seems to Prof. Sampson a simpler hypothesis to suppose that the intellect is limited. The quantum theory, which is obviously on the right lines, makes in small matters an enormous logical difference, and gives a new meaning to the question "Will the sun rise tomorrow ?"—for example, when we are dead, or last century, before we were born. We must confess that we have no means of verifying whether it does or not. It seems that both these theories spell the exhaustion of the constructs of the intellect, of which a necessary part is the four elements of space-time, which must be exhausted sooner or later. Leaving these philosophical questions, Prof. Sampson gave a description of the ordinary theory of stellar sequences, etc., including the Russell diagram of the relation of luminosity to spectral class, and white dwarfs.

Supervision of the Nation's Food Supply

In the fifteenth Benjamin Ward Richardson Lecture which was delivered on November 10 before the Royal Sanitary Institute, Dr. Gerald Leighton, late Medical Officer of the Department of Health for Scotland, stated that from the public health point of view three conditions are required for the proper supervision of the nation's food supply. In the first place, there must be a concentration and collection at certain centres of large quantities of the food material, so that there may be adequate inspection. Although the necessity of this condition was recognized more than forty years ago by the United States Department of Agriculture, which established a well-regulated system of slaughter houses, Great Britain has been very slow in adopting the system of public abattoirs, the need of which was so strongly urged by Benjamin Ward Richardson himself. The second condition necessary for effective supervision is the supply of a sufficient number of highly trained inspectors. Great progress has been made in this respect during the last twenty years, training for students as meat inspectors being provided by veterinary colleges, some universities and other educational bodies. Lastly, a uniformity of system and practice is essential. The inspectors should be trained to work on a uniform system and to a uniform standard instead of, as in the old days, each inspector being a law to himself. Dr. Leighton then dwelt on the desirability of securing and adopting the most rapid, skilled and humane methods of slaughtering all kinds of animals for human food, a topic which formed part of the life work of Richardson. In conclusion, he expressed the view that in the progress of the supervision of a nation's food, the introduction of legal standards, as in most European countries, America and various parts of the Empire, for the majority of foods is the most important step for future development.

The London Telephone Trunk Exchange

In a paper read on November 13 to the Students' Section of the Institution of Electrical Engineers, Mr. H. M. Wells discusses the effects of the rapid increase of the telephone service in Great Britain on the methods of working. The country is divided up into zone areas and subdivided into group areas. Major trunk lines connect main zone exchanges with London and with one another. They are so designed that a minimum of duplicate plant is necessary. By the use of thermionic amplifiers, the volume of speech fed into a line is made equal to the volume received at the far end. When things are properly adjusted, there is thus no loss of sound. One result is that the speech on the London-Moscow circuit is as good as that on a local London call. The insulation materials of the cables used are paper and 'air-space'. The 'air-space' is filled with carbon dioxide which possesses desiccating qualities and

can be readily pumped out from the cable and replaced by fresh gas capable of restoring the dry atmosphere required to maintain a high insulation resistance. In the exchange itself, the type of apparatus employed is designed to permit calls to be completed on demand, that is, whilst the calling subscriber is held on the line. Timing the duration of calls is a problem which has received special attention. In the trunk exchanges, all calls are timed automatically; this obviates any error due to the human element, and, as the calls are expensive, this is very desirable. The particulars from the time-recording instruments, together with the called and calling subscribers' numbers, are entered on a ticket by the operator and circulated to a central pricing position. The circulation is effected by pneumatic tubes. The power for the exchange is derived from secondary cells of large capacity. A voltage of 50 is used for normal speech and apparatus purposes, but the signalling lamps on the switchboard are worked at six volts from an alternating current source.

Grading of Teak Squares

WITH the hearty co-operation of business firms, the Forest Research Institute at Dehra Dun has published a small pocket monograph entitled "Rules for the Grading of Teak Squares", prepared by L. N. Seaman, officer in charge, Timber Testing Station, and V. D. Limaye. In a preface, Mr. C. G. Trevor, Inspector General of Forests, states that the work was undertaken at the request of the Chief Conservator of Forests, Burma, and the Indian Railways, and the Burma forest officers were deputed to the saw mills of the five chief teak firms to observe and write down in tabular form all the defects in each teak square passed by the respective firms as belonging to different existing grades. The data so obtained were dispatched to Dehra Dun for analysis, and preliminary draft rules were drawn up by Mr. Seaman and his staff. These rules were discussed at a meeting held in Rangoon between the parties interested, and a trial was made of them. As a result of experience gained, the rules were re-written by Mr. Limaye (Mr. Seaman having left India on retirement) and are now published in the present handy form. The rules express, in so many words, the actual practice that is followed in the trade in the grading of teak squares. The rules have been accepted by the teak lessees of Burma and the timber adviser to the Railway Board and the Army. The rules are equally applicable to mill-sawn squares from Siam and other countries, and it is suggested that in future they will always be used for the buying and selling of teak squares.

Design in Industry

AT the opening meeting of the new session of the Royal Society of Arts on November 4, the chairman of the Council, Sir Henry McMahon, announced the institution of a new distinction of D.I. (Designer for Industry) for designers for industry who have attained eminence in creative design. The distinction is limited in the first instance to ten and the number of holders of it at any one time will not exceed thirty. The essence of the scheme is to encourage the improvement of industrial design by enhancing the status of the designer in the public regard, and thereby arousing a more general recognition of the importance of industrial art. This latest step is in continuance of the Society's efforts in this field from the eighteenth century onward, and is a natural development of the annual competition of industrial designs initiated in 1923 and of the Exhibition of British Art in Industry organized at Burlington House last year in co-operation with the Royal Academy. The very success of the Exhibition, which stimulated a widespread movement advocating the cause of art in industry, emphasized the fact that no recognition or distinction was heretofore available for designers, who through their great work for industry are deserving of wide public recognition of their valuable services to their country. This gap, it is hoped, will be filled by the new distinction.

The *Geographical Magazine*

THE completion of the second year of the *Geographical Magazine* directs attention to the value of its articles and the excellence of its illustrations, the photogravure and coloured plates in particular reaching a high standard. Among articles in the December issue is one by Dr. R. Zeller on the "Development of Alpinism in Switzerland" which is illustrated by a large number of old prints. In view of the modern vogue of alpinism, which the writer defines as an interest in high mountains and their exploration, it is worth noting that at least until the eighteenth century the Alps repelled travellers. The influence of two writers, von Haller and Rousseau, did much to direct attention to the Alps, but with a few exceptions there was little real mountaineering until Paccard and Balmat climbed Mont Blanc in 1786. Maps did not become available until the nineteenth century, and from the middle of that century onwards accurate maps and guide books were great stimuli to active alpinism, while the twentieth century may be said to have seen its popularization.

Demographic Statistics

ACCORDING to statistics recently published in Germany, the average duration of human life in most countries was about fifteen years longer in 1921 than in 1871. In 1880 in Germany, 261 out of 10,000 inhabitants died as compared with 212 in 1900 and 111 in 1930. During the same periods there were 205, 182 and 114 deaths in England, and 198, 176 and 113 in the United States. In Hungary the decline of mortality was most pronounced, there being 386 deaths per 10,000 inhabitants in 1880 and only 155 in 1930. During the same period of half a century, the percentage fall of mortality in different countries was as follows: Germany, 54·8; England, 44·4; France, 22·6; Italy, 41·7; Switzerland, 51·8; Sweden, 39·7; United States, 40·4; and Australia, 46·9 (*Bruxelles Méd.*, October 25).

International Congress for Applied Mechanics

THE fifth International Congress for Applied Mechanics will meet in Cambridge, Massachusetts, on September 12–16, 1938, at Harvard University and the Massachusetts Institute of Technology. The programme will cover three main divisions of applied mechanics as follows: (1) structures, elasticity, plasticity, fatigue, strength theory, crystal structure; (2) hydro- and aero-dynamics, gas dynamics, hydraulics, meteorology, water waves, heat transfer; (3) dynamics of solids, vibration and sound, friction and lubrication, wear and seizure. Further information can be obtained from the Secretary, Fifth International Congress for Applied Mechanics, Massachusetts Institute of Technology, Cambridge, Mass.

Announcements

PROF. G. I. TAYLOR will deliver the Christmas Lectures "adapted to a juvenile auditory" at the Royal Institution, 21 Albemarle Street, London, W.1 on December 29 and 31 and January 2, 5, 7 and 9. The subject of the lectures will be "Ships". Further information can be obtained from the Assistant Secretary.

THE following appointments and promotions in the Colonial Service have recently been made: Lieut.-Commander J. R. de la Haule Marett, to be assistant in ethnology, Colombo Museum, Ceylon; J. A. Richardson, to be field geologist, Malaya; F. J. Ryeland, to be inspector of mines, Gold Coast; J. R. Lockie (assistant conservator of forests, British Guiana), to be assistant conservator of forests, Nigeria; F. R. H. Green (inspector of mines, Kenya), to be superintendent of surveys, Lands and Mines Department, British Guiana; V. T. Hockin (assistant inspector of mines), to be inspector of mines, Tanganyika; S. Napier-Bax (senior field officer), to be assistant director, Tsetse Research Department, Tanganyika; Capt. A. T. A. Ritchie (game warden, Kenya), to be chief game warden, Federated Malay States; N. H. Vicars-Harris (assistant director, Tsetse Research Department), to be secretary of the Department of Lands and Mines, Tanganyika.

AN annual sum of about £30 is available from the Clough Memorial Research Fund, which was instituted in 1935 for the purpose of encouraging geological research in Scotland and the north of England (Northumberland, Cumberland, Westmorland, Durham and Yorkshire). Applications for grants are invited for the period April 1, 1937–March 31, 1938. Further information can be obtained from the Secretary, Clough Memorial Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh.

PROF. FRIEDRICH ZAHN, president of the Bavarian Statistical Office, has been nominated president of the International Statistical Institute.

PROF. EMIL ABDERHALDEN, director of the Physiological Institute at Halle, has been nominated an honorary member of the Sociedad Cubana de Biologia.

VIENNA has the lowest birth-rate in the world; in 1935 there were only 7 births per 1,000 inhabitants. In March 1936, there were 978 births, of which 496 were males and 482 females, while there were 2,219 deaths, of which 1,123 were males and 1,096 females, so that in a single month the population fell by 1,243.

ERRATUM.—In the record of the award of the Darwin Medal of the Royal Society in NATURE of December 5, p. 980, for Edgar James Allen, read Edgar Johnson Allen.

IN NATURE of November 28, p. 914, it should have been stated that the Rev. Wm. Tuckwell's surviving daughters are Miss Gertrude Tuckwell and Mrs. Marian Ethel Grew; Lady Welch died three years ago.

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

Engineer in a War Department establishment at Sutton Oak, Lancs—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, London, S.W.1 (December 15).

Scientific officers (chemistry), junior scientific officer (chemistry or physics), assistants (Grades I, II and III—chemistry) in the Chemical Defence Research Department—The Chief Superintendent, 14 Grosvenor Gardens, London, S.W.1 (December 15).

Mechanical engineering designer in the Design Department, Royal Arsenal, Woolwich—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (Quote Appts./9) (December 15).

Assistant lecturer in civil engineering in the City and Guilds College—The Secretary, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W.7 (December 15).

Head of the Engineering Department of the North Staffordshire Technical College—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (December 16).

Assistant in the Research and Technical Publications Section of the Air Ministry—The Secretary, Air Ministry, Adastral House, Kingsway, W.C.2 (December 19).

Biochemist in the Royal Berkshire Hospital, Reading—The Secretary (December 31).

Research officer on the scientific staff of the Agricultural Research Council for work on coccidiosis—The Secretary, 6A, Dean's Yard, Westminster, S.W.1 (January 1).

Lecturer in mechanical engineering in the Derby Technical College—The Clerk to the Governors (January 4).

Physicist in the Research and Development Department of the Cambridge Instrument Co., Ltd., Cambridge.

Lecturer in pathology of the diseases of infancy and childhood in the University of Glasgow—Secretary of the University Court.

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. 1018.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

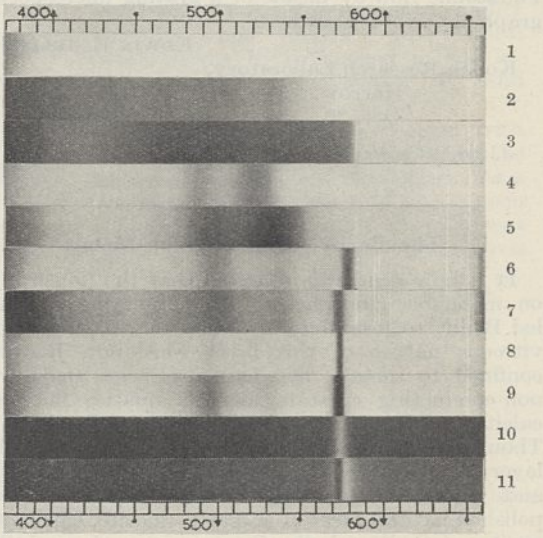
Spectral Absorption and Fluorescence of Dyes in the Molecular State

As Prof. R. W. Wood has stated on p. 648 of his "Physical Optics" (3rd ed.) that no liquid or solution has been found to exhibit the slightest trace of resonance radiation, it seems of interest to record that the effect has now been observed. It has been found possible to prepare suspensions of many dyes in solids and liquids, which possess an extraordinarily narrow absorption band associated with fluorescence of slightly longer wave-length. Three more or less general methods of preparation have been discovered, which possess the common feature that they cause the dye to pass from the dissociated state in true solution, through a transitory molecular state which exhibits a characteristic absorption and fluorescence, to the crystalline state. The effect is shown in a particularly striking manner by the dye 1 : 1′ diethyl-ψ-cyanine chloride, for which details of the three methods of obtaining the molecular absorption spectrum are given.

Method 1. A concentrated solution of 1 : 1′ diethyl-ψ-cyanine chloride in a strongly polar solvent, such as nitrobenzene or pyridine, was rapidly diluted with a non-polar or feebly polar liquid such as ligroin, carbon tetrachloride, benzene, toluene or xylene. The liquid became fluorescent and exhibited a very sharp absorption band having a maximum at $\lambda = 576$ mμ. The position of the band was somewhat different for the different halides of the dye. Both the fluorescence and the absorption band rapidly disappeared as the dye passed into the crystalline state.

Method 2. The dye was dissolved in a fused strongly polar substance, for example, benzophenone, which was then crystallized by sudden chilling, whereby some of the dye remained molecularly dispersed in the solid. The position of the band depended on the particular salt of the dye, but did not seem to depend on the solid in which it was dispersed. It has been found that the sharp absorption band is not dichroic (not a function of the vibration direction), whereas absorption bands of crystals of the dye are strongly dichroic. This method is a general one for salts of basic dyes. The molecularly dispersed dyes slowly pass into a micro-crystalline condition, and the sharp absorption band disappears as this takes place.

Method 3. A solution of the dye in methyl or ethyl alcohol was added to 5*M* sodium chloride solution. The liquid became strongly fluorescent, and exhibited a very sharp absorption band at 574 mμ. The fluorescence consisted of a narrow band having a maximum intensity at 577mμ, which was excited almost entirely by the absorption band at 574 mμ. On heating the liquid to 60° the molecular absorption and fluorescence disappeared, and were replaced by the characteristic absorption spectrum given by the dye cations in alcoholic solution. On slowly cooling, the molecular absorption and fluorescence gradually increased in intensity, and the cation absorption correspondingly diminished. Similar reversibility was shown on varying the concentration of alcohol. A number of other dyes which have been examined behave in the same way, but the duration of molecular absorption may be anything from a fraction of a second to some weeks.



(1) Spectrum of tungsten arc lamp (containing neon).
(2) and (3) The two principal absorptions corresponding to the *X* and *Y* vibration directions of crystals of 1 : 1′ diethyl-ψ-cyanine chloride.
(4) Absorption spectrum of the dye in methyl alcohol.
(5) Absorption spectrum of the dye in nitrobenzene.
(6) Absorption spectrum of a molecular suspension of the dye in toluene.
(7) Absorption spectrum of the dye molecularly dispersed in benzophenone crystals.
(8) and (9) Absorption spectra of two different concentrations of the dye in sodium chloride solution.
(10) Fluorescence spectrum of the dye in sodium chloride solution.
(11) Fluorescence spectrum of the dye in sodium chloride solution. In this case the fluorescent light has been made to traverse a small thickness of unilluminated solution, so that the absorption band is seen superimposed on the fluorescence band. It will be noticed that the two do not exactly correspond.

On illuminating the fluorescent liquids with plane polarized light, the fluorescence was found to be unpolarized, showing that there is a time interval between the absorption and re-emission of light. The fluorescence is, therefore, visible when the liquids are examined between crossed nicols with a polarizing microscope. This is further proof that the fluorescence is a resonance effect, and is not light scattered by small solid particles of dye. It has also been noted

that the dye in the molecular state shows a strong tendency to adsorb on the walls of the containing vessel, and in some experiments such adsorbed films showed the sharp molecular absorption band and associated fluorescence for a minute or so after their preparation, but the effect rapidly disappeared as the film passed into the crystalline state. Dyes adsorbed on filter paper, cotton wool, kaolin, etc., frequently possess an absorption maximum agreeing in position with the molecular band. This seems to indicate that some of the adsorbed dye is present in the molecular state.

A similar type of very narrow absorption band associated with fluorescence of approximately the same wave-length was discovered in the ruby by Ebert, and was examined in detail by Mendenhall and R. W. Wood. The ruby consists essentially of a crystal of aluminium oxide containing dissolved chromium oxide. The method of preparation of synthetic rubies corresponds in principle with the present method of producing the molecular absorption band of 1 : 1′ diethyl-ψ-cyanine dispersed in a solid crystalline substance.

These phenomena are illustrated in the attached spectrograms which were photographed on 35 mm. Panatomic film by means of a grating microspectrograph described elsewhere[1].

EDWIN E. JELLEY.

Kodak Research Laboratory,
Harrow.
Oct. 29.

[1] *J. Roy. Micr. Soc.*, **56**, 101–112 (1936).

The Beilby Layer on Non-Metals

IT is now generally accepted that the polish layer on metals is amorphous. The observations which led Beilby to formulate his famous conception of the vitreous nature of this layer were not, however, confined to metals, but had also been made with non-conducting crystals such as quartz, fluorspar, calcite and others. But Hopkins[1], working in G. P. Thomson's laboratory, has shown that the polish layer on Iceland spar cleavage faces is crystalline; and Raether's[2] electron diffraction patterns from polished natural faces of rocksalt, fluorite, calcite and pyrites are also wholly characteristic of crystalline structure. Nevertheless, the directness and simplicity of his experiments, in particular the exposure by etching of scratches eliminated by polishing, seem to speak convincingly in favour of Beilby's views.

Recently we have examined a wide variety of polished non-metallic single crystal surfaces, with results which go far towards reconciling the apparent conflict of evidence hitherto afforded by Beilby's microscope and the electron diffraction camera. Thus we have found that, whilst polished plane surfaces, cut in quite arbitrary directions from many types of single crystals (quartz, diamond, natural and synthetic sapphires, almandine and demantoid garnets, topaz, chrysoberyl, epidot, olivine, sphene, andalusite), yield electron diffraction patterns of spots and lines and thus provide irrefutable evidence of the crystalline structure of the polish layer on such surfaces, other crystals, notably white beryl, zircon, tourmaline, cassiterite and hæmatite, give the pattern of diffuse haloes more or less submerged in background which is so characteristic of liquid mercury, glasses, vitreous silica and of the amorphous Beilby layer. From other polished crystal facets (brown beryl, moonstone, orthoclase and cordierite) composite patterns were obtained in which the single crystal pattern showed faintly through that due to the amorphous layer. Spinels, both synthetic and natural, yielded either halo patterns or haloes and spots, only faintly distinguishable through the general background scattering. In some cases the structure of the polish layer appeared to be determined by the crystallographic nature of the facet examined. Thus one facet of a blue kyanite yielded a Beilby layer pattern through which single crystal spots were faintly distinguishable, whilst other facets of the same specimen gave single crystal patterns. Again, though the end faces of the prisms of a Zeiss nicol afforded quite good single crystal patterns, those from the junction faces were characteristic of the true amorphous Beilby layer. After etching, which revealed many coarse grinding scratches on all these faces, only typical single crystal patterns were obtained.

These results seem clearly to establish the validity of Beilby's view of the formation of the polish layer. That the layer is, however, often crystalline may be ascribed, except perhaps in the case of the diamond where polishing is possibly the effect of attrition alone, to a ready and spontaneous re-ordering of the molecules, disarranged by the act of polishing, in more or less strict orientation with those of the crystal matrix; whilst the amorphous nature of the polished surfaces of other crystal facets is evidence of the reluctance of the flowed layer to recrystallize; a reluctance which appears to be determined in some cases by the nature of the mineral, in others by the crystallographic direction of the polished facet.

Carborundum affords an example of a chemically formed amorphous polish layer. The untreated crystals, even though possessing perfect mirror-like surfaces, invariably yield typical Beilby layer patterns. Abrasion with fine emery paper (mainly rouge and aluminium oxide) or immersion in hydrofluoric acid appear to have no visible effect; nevertheless, after either of these treatments, carborundum flakes furnish single crystal patterns of quite exceptional clarity. Presumably the raw crystal surfaces are covered by a thin film of glassy silica formed by superficial oxidation during cooling of the charge[3].

An important result of these experiments is that the study of the diffraction of electrons by single crystals need no longer be confined to the often imperfect natural or cleavage faces. Any desired type of face can be exposed for this purpose by grinding and polishing, followed by etching in those cases where the polish layer happens to be amorphous. Finally, we have obtained good single crystal patterns from all over the curved surface of a short-focus plano-convex quartz lens. Thus every conceivable crystal plane should be accessible to the electron beam in a single crystal ground and polished as a sphere.

G. INGLE FINCH.

Imperial College,
South Kensington,
London, S.W.7.
Nov. 9.

[1] Hopkins, *Phil. Mag.*, **21**, 820 (1936).
[2] Raether, *Z. Phys.*, **86**, 82 (1933).
[3] Germer, *Phys. Rev.*, **49**, 163 (1936), also obtained a halo pattern from carborundum and concluded that this vitiated the usual interpretation of the haloes obtained from polished surfaces; had he, however, removed the glassy film due to surface oxidation, a single crystal pattern would certainly have been obtained.

Scattering of Neutrons by Protons

THEORETICAL investigations of the interaction of protons and neutrons have been given by Wigner, Heisenberg and Majorana. A very valuable check on their conclusions is provided by the study of the scattering cross-section of the hydrogen nucleus for neutrons of various energies. Cross-sections have been measured for neutrons of low energies (a few volts) by Fermi and his collaborators[1]; for the photo-neutrons from heavy hydrogen (energy about 250 k.v.) by Goldhaber[2]; and for the neutrons obtained by bombarding carbon with heavy hydrogen (600–1,200 k.v.) by Tuve and Hafstad[3]. Dunning[4] also gives a value for the fast portion of the continuous spectrum of radon-beryllium neutrons, of which the average effective scattering energy probably lies in the region of 3–4 m.e.v.

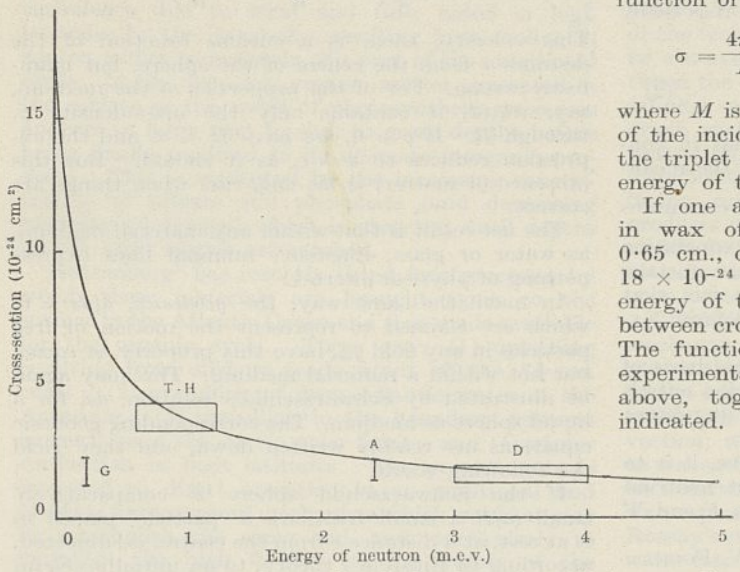


FIG. 1. The curve represents Wigner's theoretical neutron-proton scattering cross-section for neutrons of various energies. Experimental results of various investigators are also shown: G = Goldhaber; T-H = Tuve and Hafstad; A = Booth and Hurst; D = Dunning.

We have measured the cross-section of protons for the 2·4 m.e.v.[5] neutrons obtained from the D + D reaction. A fast neutron detector, consisting of an indium foil embedded in a block of paraffin wax 9·5 cm. × 5·5 cm. × 6·5 cm. was placed 23 cm. from the heavy phosphoric acid target. This detector was wrapped in cadmium foil to prevent so far as possible the entrance of any slow neutrons reflected from the surrounding walls: extraneous neutrons would tend to make the measured value of the cross-section too low. The scatterer consisted of a sheet of paraffin wax 7·7 cm. long, 4·8 cm. wide and 1·85 cm. thick. This was placed midway between the target and the detector. A thin packet of phosphorus, which responds only to fast neutrons, was placed near the target to enable a correction to be made for small variations in the intensity of the neutron source. The activities induced in the phosphorus and indium were measured on a Geiger-Müller counter.

Ten runs, five with and five without the scatterer, were made. After correcting for neutrons which were scattered and yet entered the detector, a free path of 4·6 ± 0·9 cm. was obtained for the neutrons in the wax. For the carbon correction, we adopted Dunning's value of 1·7 × 10^{-24} cm.^{2} for the scattering cross-section, for fast neutrons in carbon. After applying this correction we find a cross-section of (1·8 ± 0·4) × 10^{-24} cm.^{2} for 2·4 m.e.v. neutrons scattered by protons.

A theoretical formula, assuming singlet and triplet states for the neutron-proton system, has been derived by Wigner. This gives the cross-section as a function of energy in the form

$$\sigma = \frac{4\pi\hbar^2}{M}\left[\frac{1}{4}\cdot\frac{1}{\varepsilon^1 + \frac{1}{2}E_0} + \frac{3}{4}\cdot\frac{1}{\varepsilon + \frac{1}{2}E_0}\right],$$

where M is the mass of the proton, E_0 is the energy of the incident neutron, ε is the binding energy of the triplet state (2·15 m.e.v.) and ε^1 is the binding energy of the singlet state.

If one adopts Fermi's value for the free path in wax of the DABI neutron groups, namely, 0·65 cm., corresponding to a cross-section of about 18 × 10^{-24} cm.^{2}, one can determine the binding energy of the singlet state and obtain the relation between cross-section and energy of incident neutron. The function is shown graphically (Fig. 1). The experimental results of the investigators mentioned above, together with our own value, are also indicated. The agreement between theory and experiment is satisfactory at the higher energies, but further experimental work seems to be needed in the intermediate region between 0·1 and 1 m.e.v.

A target of heavy ice cooled with liquid air has been installed since the above experiment was completed. As a consequence the neutron yield has been increased by a factor of five, and we hope to repeat the measurements using phosphorus as the neutron detector.

E. T. BOOTH.
C. HURST.

Clarendon Laboratory,
Oxford.
Nov. 13.

[1] Amaldi and Fermi, *Ricerca Scientifica*, **1**, 310 (1936).
[2] Goldhaber, NATURE, **137**, 824 (1936).
[3] Tuve and Hafstad, *Phys. Rev.*, **50**, 490 (1936).
[4] Dunning, *Phys. Rev.*, **45**, 586 (1934).
[5] Bonner and Brubaker, *Phys. Rev.*, **49**, 19 (1936); and *Proc. Roy. Soc.*, A, **148**, 623 (1935).

Inconsistency of the Neutrino Theory of Light

The neutrino theory of light proposed by Jordan[1] postulates a connexion between the quantized wave function of the light field (F) and that of the neutrino field (Ψ). Since Ψ satisfies the commutation rules for Fermi statistics and F those of the Bose statistics, the connexion cannot be a linear one. On the other hand, we know from quantum electrodynamics that F satisfies a linear differential equation; a similar equation of d'Alembert's type is to be expected for Ψ. Thus a contradiction arises between the linearity of the equations and the non-linearity of the connexion between F and Ψ. (This contradiction is avoided only in the case of plane waves propagating in one definite direction.) Besides, serious doubts arise as to the possibility of expressing the quantized amplitudes $b(\nu)$ for F (Bose statistics) in terms of the amplitudes $\gamma(\nu)$ for Ψ (Fermi statistics), the operators $b(\nu)$ and $\gamma(\nu)$ being of a quite different mathematical nature.

Jordan proposes[2] the following expression :

$$\sqrt{\nu}\, b(\nu) = \int_{-\infty}^{+\infty} \gamma^{+}(\alpha)\gamma(\nu+\alpha)\, d\alpha \qquad (1)$$

But it may be shown that the operators $b(\nu)$ so defined commute with one another as well as with the conjugate operators. In fact, applying the Fourier transformation from $\gamma(\alpha)$ to $\Psi(x)$, it is easily seen that (1) is equivalent to

$$\sqrt{\nu}\, b(\nu) = \int_{-\infty}^{+\infty} e^{-i\nu x}\Psi^{+}(x)\Psi(x)\, dx \qquad (2)$$

The operator on the right-hand side has in configuration space of n particles (neutrinos) the meaning : multiplication by $\sum_{k=1}^{n} e^{-i\nu x_k}$ and thus commutes with the conjugate one. The converse conclusion reached by Jordan is obviously due to some mistake in his calculations, most probably to the fact that he implicitly uses in his arguments indefinite expressions of the form $\infty - \infty$.

Since the relation (1) is the mathematical basis of Jordan's theory, the disproof of this relation entails the failure of the whole theory, at least in its present form.

From general arguments developed above, it is to be expected, however, that no consistent neutrino theory of light based on a relation between F and Ψ can be constructed.

V. Fock.

Physical Institute,
University, Leningrad.
Nov. 1.

[1] *Z. Phys.*, **93**, 464 (1935).
[2] P. Jordan, "Anschauliche Quantentheorie" (Berlin : Springer, 1936), p. 269.

Minimal Lines and Geodesics within Matter: a Fundamental Difficulty of Einstein's Theory

According to Einstein's relativity theory *the minimal lines*, $ds^2 = g_{ik}dx_i dx_k = 0$, represent, in any circumstances (that is, in space-time upon which any metrical tensor g_{ik} satisfying the field-equations has been impressed), *light-lines*, and thus the laws of propagation of light. Now, *in vacuo*, the representation is of course correct, giving—apart from minor refinements—uniform, isotropic propagation with the velocity c, as pre-arranged. But inside matter, considered as a continuous medium characterized by the material tensor T_{ik}, the minimal lines manifestly *cannot represent light propagation*, even to a rough approximation. For in such a medium, supposed isotropic, the light velocity is, essentially, c/μ (where μ is the refractive index, say, for light of a fixed frequency), whereas T_{ik}, determining the g_{ik}, contains no trace of μ, in fact, no properly optical feature of the medium in question. Thus, even without detailed mathematical deduction, one can see that, *within matter*, minimal lines are *not* light-lines ; that is, $ds = 0$ does not represent light propagation.

To illustrate my point, let us consider the case of Schwarzschild's incompressible liquid sphere in equilibrium, that is, $T_1^1 = T_2^2 = T_3^3 = -p/c^2$, $T_4^4 = \rho$ (density) = constant, for which the complete solution is available. Take, for example, the case of purely radial propagation. Then, rigorously,

$$ds^2 = \frac{1}{4}\left(3\cos\frac{a}{R} - \cos\frac{r}{R}\right)^2 c^2dt^2 - dr^2,$$

where r is radial length in 'natural measure', $r = a$ the boundary of the sphere, and $R = c\sqrt{3/8\pi k\rho}$ the curvature radius of the manifold within the sphere (k = gravitational constant). Thus the minimal lines give for the velocity of propagation :

$$v = \frac{c}{2}\left(3\cos\frac{a}{R} - \cos\frac{r}{R}\right).$$

This velocity, then, is a curious function of the distance r from the centre of the sphere, but manifestly wrong. For of the properties of the medium, say, water, it contains only the mass-density ρ, through R. If $\rho = 0$, we have $R = \infty$ and the expression reduces to $v = c$, as it should. But this (absence of matter) *is the only case* when things are correct.

The net result is that within any material medium, as water or glass, Einstein's minimal lines express nothing of physical interest.

In much the same way, the *geodesics*, $\delta\int ds = 0$, which are claimed to represent the motion of free particles in any field g_{ik}, have this property *in vacuo*, but not within a material medium. This may again be illustrated by Schwarzschild's solution, ds, for a liquid sphere as medium. The corresponding geodesic equations are readily written down, and they yield the following result.

If the Schwarzschild sphere is comparatively small (a/R a small fraction), a 'particle' placed in it at rest, at a distance r from the centre, is subjected, according to Einstein's theory, to an initial acceleration

$$E = -\frac{4\pi k\rho}{3}r,$$

towards the centre, no matter what the density (ρ_p) of the particle itself, whereas the (approximately) correct, Newtonian acceleration is, of course,

$$N = \frac{4\pi}{3}k\rho r\left(\frac{\rho}{\rho_p} - 1\right).$$

The Einsteinian acceleration E, as claimed by the geodesic, happens to agree with the Newtonian acceleration N when $\rho_p = \infty$, but in no other case. Of course, the correct acceleration would come out if we had supplemented the geodesic equations by the resultant of the pressures of the liquid upon the surface of the particle (Archimedes). But we are concerned here with the pure *geodesics* as characteristic lines of the four-dimensional manifold.

In fine, in the geodesic scheme, no account whatever is taken of the 'density' of the immersed test particle. The failure of the geodesics as representatives of motion within a material medium is quite analogous to that of the minimal lines, where no account is taken of the features of the immersed light, so to speak (namely, of its frequency entering into μ or into the dielectric constant of the medium). In fine, similarly to the minimal lines, the geodesics within matter express nothing of physical interest.

The whole part of Einstein's theory which claims to deal with the phenomena within material media would, then, have to be thoroughly rebuilt, which seems scarcely possible without entering into the granular structure of matter—a formidable task.

Ludwik Silberstein.

14 St. Mary's Street,
Toronto.
Oct. 18.

An Ecological Aspect of the Gulf Stream*

THE view has been increasingly accepted, since first put forth by Nathansohn[1], that the fertility of the sea depends upon the restoration to the surface of plant nutrients such as phosphates and nitrates liberated by the decomposition of organic matter within its depths. In shallow coastal waters the turbulence due to wind and tide, aided in high latitudes by the instability resulting from cooling in winter, suffice to maintain this part of the nutritional cycle. In the deep sea, organic matter generated in the surface as the result of photosynthetic processes appears in large part to sink to great depths before being finally oxidized to its ultimate inorganic products. This is evidenced by the increasing concentration of nitrate and phosphate (and decreasing quantity of oxygen) which is observed until depths of 800–1,000 metres are reached.

Wattenberg[2] has recently listed four processes by which these materials are brought again to the surface in the Atlantic Ocean and thus made available for the organic cycle. These are: (1) upwelling resulting from offshore trade winds off the African coast; (2) upwelling of deep Atlantic water in the Antarctic; (3) upwelling in the boundary between currents as in the Arctic polar front; and (4) winter convection in high latitudes. The present note is intended to direct attention to an additional and hitherto unrecognized mechanism which would appear to accomplish the same end and particularly to maintain the high fertility of the waters of the eastern coast of North America.

In a paper entitled "The Dynamics of Steady Ocean Currents in the Light of Experimental Fluid Mechanics", Rossby[3] has shown that the Gulf Stream may be likened to a wake stream discharging into the upper layers of a stratified medium. A wake stream, which appears to be a divergent current, is actually drawing in water from the surroundings. In a stratified medium the boundary between the layers must dip down towards the right in the northern hemisphere, as the isopycnics are observed to do in sections across the Gulf Stream, and this dip is to be regarded as the result rather than the cause of the current flow. The compensating movements set up in the surroundings of a wake stream must have a component in the direction of the current itself on the right side. The Antilles current appears to be such a compensating current. On the left side, the compensating movements must appear as a counter current, represented by the slope water of the American coast.

It is brought out that the absorption of water into the wake stream must take place primarily along the right edge, and that water will be ejected from the wake stream into the counter current. It results that water may be transferred across the current from the open ocean basins to the right into the limited body of water to the left of the current. This lateral transport must take place principally along isopycnics, which are known to slope sharply as they cross the Gulf Stream. Water is thus carried upward as well as shoreward as the result of the primary stream.

The observations of Seiwell[4] on the distribution of oxygen and phosphate in the north Atlantic make it clear that the apparent site of maximal decomposition of organic matter lies much closer to the surface (250 metres) in the continental slope water than in mid-ocean (800 metres). Such a large difference cannot reasonably be ascribed to differences in the rate of sinking or of decomposition of organisms in the contrasted localities. The findings are, however, entirely consistent with the wake stream theory developed by Rossby, since on this view the slope water is derived in considerable part from water absorbed at a greater depth along the offshore edge of the Gulf Stream. The close correlation which may be observed in a section across the Gulf Stream between the conservative properties of temperature and salinity, on one hand, and the properties of biological origin such as oxygen, phosphate and nitrate concentration, on the other, suggests that the observed distribution of the latter is the result of hydrographic factors rather than biological action *in situ*. The products of decomposition which appear at a depth of 200–300 metres in the slope water may have been actually derived from a much greater depth in the open ocean.

Rossby's wake stream theory thus provides a mechanism for the transport of water rich in organic nutrients from the depths of the Atlantic basin on to the edge of the continental shelf. Here it comes within the influence of tidal mixing and winter convection, which complete the transport of nutrients to the surface. The latter stages in the process may be observed in the Gulf of Maine, into which slope water penetrates, and along the continental shelf[5]. Rossby's study suggests that the absorption of oceanic water into the Gulf Stream takes place chiefly south of the latitude of Chesapeake Bay; the discharge of this water at a lesser depth occurs from Chesapeake Bay to at least Nova Scotia. If his theory is correct, he has discovered a mechanism on which the fertility of the waters of the Atlantic Coast of North America must largely depend.

ALFRED C. REDFIELD.

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Cambridge, Massachusetts.

* Contribution No. 122 from the Woods Hole Oceanographic Institution.

[1] A. Nathansohn, *Abhand. Konigl. sachs Gesel. der Wissensch. Leipsig*, **39**, 3 (1906).
[2] C. W. Correns, A. Defant, F. Gessner, W. Stahlberg. V. Schubert, H. Wattenberg and B. Wüst, "Tiefseebuch" (Berlin, 1934).
[3] C. G. Rossby, "Papers in Physical Oceanography and Meteorology", **5**, No. 1 (1936).
[4] H. R. Seiwell, "Papers in Physical Oceanography and Meteorology", **3**, No. 1 (1934). *ibid.*, **3**, No. 4.
[5] H. B. Bigelow, "Papers in Physical Oceanography and Meteorology", **2**, No. 4.

Devernalization of Winter Rye by High Temperature

ALTHOUGH the effect of low temperature in inducing vernalization is now well established, it is by no means clear to what this effect is due. It appeared possible that the mere check in growth at low temperature is the chief factor. The results of Vasiljev[1], which showed that when the period of low temperature treatment is included the time taken to flower remains nearly constant, lends support to this view.

Experiments were therefore performed in which growth was checked by keeping the imbibed grain in an atmosphere of nitrogen for varying periods of time. At low temperature (1° C.) this may be extended to twelve weeks, and the seeds on exposure to air are viable and produce normal plants. They are, however, unvernalized. At 20° C. the seed does not remain viable if the continuous anærobic period extends for more than three weeks. After such a period of checked growth, the further time required to flower is equal to that required by untreated plants.

It may therefore be stated that the check to growth is not the potent factor in vernalization, but that the effect must be attributed to the low temperature. This result also confirms the statement of Lysenko[2] that oxygen is necessary for the vernalization process.

FIG. 1.

By giving periods at 1° C. in air, alternating with periods in nitrogen at 20° C., it was possible to test whether high temperature can act antagonistically to low temperature. The alternating periods varied from six days in air at 1° C. followed by one day in nitrogen at 20° C., to one day in air at 1° C. followed by one day in nitrogen at 20° C., in each case the total period at 1° C. being six weeks. The controls were kept at low temperature continuously, but were in air and in nitrogen for alternate days for a total period of twelve weeks, thus also receiving six weeks of normal low-temperature treatment. The controls were all vernalized, whereas when the alternating periods in nitrogen were at 20° C. and of equal duration to the cold periods, vernalization was prevented. The results of four series with varying ratios of exposure to high and low temperatures are shown in the accompanying table.

Winter rye: total period at 1° C., six weeks in every case.

Treatment Duration in air at 1° C. Duration in N at 20° C.	Days to anthesis from planting (average of those plants which eared)	Proportion of vernalized plants
1 : 1	unvernalized	None
2 : 1	106	20 per cent
3 : 1	99	60 ,, ,,
6 : 1	89	100 ,, ,,
Control	71	100 ,, ,,

The results show that high temperature negatives the effect of low temperature progressively as the relative period of high temperature is increased; further, this effect is not directly due to the anærobic condition as the control experiments show.

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O. N. PURVIS.

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[1] I. M. Vasiljev (1934). Quoted as reference No. 28 in N. I. Maximov, "The Theoretical Significance of Vernalisation", I.A.B. Herbage Publication Series, Bull. 16, Dec. 1934.
[2] *ibid.*, p. 8.

Colloids and the Biological Effect of Radiation

IN a previous publication[1] I have pointed out that the problem of the primary process of the effect of radiation on living objects is a question of the action of rays on the different colloidal systems of the living cell. Therefore the question arises whether it is necessary to assume a special colloidal-chemical theory for the biological action of radiation.

The present investigation was undertaken to obtain information regarding the effect of ultra-violet light on colloids. Proteins, the most important colloidal constituents of the living cell, are of too complex a nature, and therefore difficult to study. As simple models, the ferric hydroxide sol (positively charged) and the negatively charged mastic and congorubin-red sol were therefore used; furthermore, I have studied the negatively charged gold and platinum sols, which were protected by decomposition derivatives of protein. These colloids are interesting models of bio-colloids. As source of light, a mercury vapour lamp was used. The exposures were made in water-cooled Petri dishes. The lamp was kept at a distance of 25 cm. above. The determination of the precipitating threshold of electrolytes (potassium chloride, hydrogen chloride, sodium hydroxide) was used as a test of the reaction to radiation.

The following results were obtained: (1) A completely negative result of irradiation in the precipitation of iron hydroxide sol; no visible change of the colour occurred, and no photo-chemical decomposition on measuring the *p*H by the electrical method of Michaelis. This completely negative effect agrees with the results of Burton[2] obtained with the electro-positive copper oxide sol. (2) The mastic sol demonstrates also no visible change, but a marked acceleration of electrolyte precipitation. This effect of irradiation outlasts the irradiation itself. An explanation of this phenomenon is only possible assuming a photo-chemical decomposition either of the particles themselves or the charging ions. (3) The irradiation of the congorubin-red sol effects a visible change of colour, making the photo-chemical decomposition of the particles very obvious. It was impossible, therefore, to precipitate the irradiated sol with electrolytes. (4) The irradiated gold and platinum sols demonstrate no visible change but a clear acceleration of electrolyte precipitation. Again this effect outlasts the irradiation itself. This effect points to a photo-chemical decomposition on the periphery of the particles, as photo-chemical decomposition of the particles themselves is not tenable. As these colloids were protected by decomposition derivatives of protein, the assumption appears permissible that the necessary photo-chemical action takes place in the protecting agents. This fact is of great importance in the examination of the action of radiation on bio-colloids, because many of them are known to be protected by light-sensitive substances.

Surveying these results, the following conclusions can be drawn: (1) The effect of ultra-violet light on colloids is purely a photo-chemical one. (2) The photo-chemical action can affect the particles themselves or their covering, for example, the protecting colloid, the charging ions. (3) The photo-chemical decomposition can cause a change of the electrical charge of the colloids corresponding to the electrical properties of the radiation, but it may also have just the opposite effect. (4) Where no photo-chemical action takes place, neither is there any change in the electrical charge. (5) In agreement with Nordenson[3]

working with ultra-violet light and gold sols, and Annets[4] working with cathode rays and many positively and negatively charged colloids, it was found that the effect of irradiation is independent of the electrical charge of colloids. (6) It appears, therefore, unnecessary any longer to postulate a special colloidal-chemical theory of the biological action of radiation. (7) The photo-chemical theory of the effect of irradiation may also be applied successfully to the phenomena observed in different colloids after irradiation.

F. ELLINGER.
Biological Institute of the Carlsberg Foundation, Copenhagen.
Nov. 10.

[1] Ellinger, "Die biologischen Grundlagen der Strahlenbehandlung" (Berlin, 1935).
[2] Burton, "The Physical Properties of Colloidal Solutions" (London, 1921).
[3] Nordenson, *Z. phys. Chem.*, **90**, 603 (1915).
[4] Annets, *J. Phys. Chem.*, **39**, 509 (1934).

Oxygen Consumption of Mayfly Nymphs in Relation to Available Oxygen

LITTLE is known of the reasons why freshwater animals are confined to certain habitats, or of the effects of their particular environments on the metabolism of the animals. The first steps in a study of these questions were reported in NATURE, **130**, 277 (1932). It has been shown that certain animals living in swift streams have a higher oxygen consumption and rate of heart beat than nearly related animals living in still waters, and that they are less resistant to water lacking oxygen[1,2,3]. The next step has been to study the oxygen consumption of such animals in terms of the available oxygen, and we have confined ourselves to mayfly nymphs. We have used *Baëtis scambus* and *Baëtis* sp. (the latter is one third the weight of the former) from a swift stream, *Leptophlebia vespertina* from Lake Windermere, *Cloëon dipterum* from a pond, and *Ephemera vulgata* living in mud in a pond. Our results are summarized in Fig. 1, in which the vertical line at an oxygen concentration of 7·9 c.c. per litre marks the oxygen content of water in equilibrium with the atmosphere at the temperature of the experiments, namely, 10°.

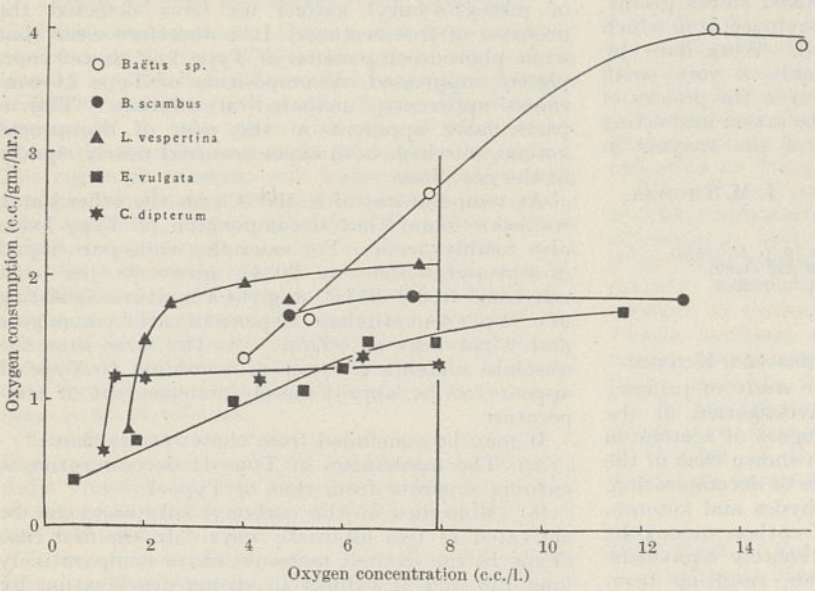

FIG. 1.

It is clear that *Baëtis* sp. and *Cloëon dipterum* present extreme contrasts: as the available oxygen falls below air saturation, the oxygen consumption of *Baëtis* sp. falls off at once, while that of *Cloëon dipterum* does not decrease until the oxygen concentration is below one fifth air saturation. The oxygen consumption of *B. scambus*, which is much lower than that of *Baëtis* sp., decreases very little when the oxygen in the water diminishes. The oxygen consumption of *Ephemera vulgata* falls as soon as the oxygen in the water begins to decrease, but less rapidly than that of *Baëtis* sp. *Leptophlebia vespertina* recalls *Cloëon dipterum*: its oxygen intake falls slowly at first, and then, below one third air saturation, it drops suddenly.

As the oxygen in the water is raised above air saturation, *Baëtis* sp. increases its oxygen consumption until it has reached one and a half times its value in Nature, while, on the contrary, the oxygen intake of *Baëtis scambus* remains steady, and that of *Ephemera vulgata* scarcely rises.

It is evident that the species most dependent on the oxygen in its environment is *Baëtis* sp., and it lives in streams where oxygen is always abundant. *Cloëon dipterum*, the most independent form, was taken from a pond in which the oxygen falls low at night in summer. But if the behaviour of these species fits their environments, that of *Ephemera vulgata* apparently does not do so, for it was found buried in mud in a pond, yet its oxygen intake drops as soon as the oxygen in the water decreases.

These results will be published in full in the *Journal of Experimental Biology*.

H. MUNRO FOX.
C. A. WINGFIELD.
B. G. SIMMONDS.
Zoology Department, University, Birmingham.
Nov. 11.

[1] H. Munro Fox and B. G. Simmonds, *J. exp. Biol.*, **10**, 67 (1933).
[2] H. Munro Fox, B. G. Simmonds and R. Washbourn, *J. exp. Biol.*, **12**, 179 (1935).
[3] R. Washbourn, *J. exp. Biol.*, **13**, 145 (1936).

Diastase in Rabbit Saliva

IT is frequently stated in general zoological literature that rabbit saliva contains an enzyme capable of hydrolysing starch to sugar. There is, however, so far, very little published experimental work to substantiate this statement. In fact, Schwartz and Rasp[1] were of the opinion that it was doubtful whether rabbit saliva contains a starch splitting enzyme of any kind. The low diastatic activity which they estimated, they were inclined to attribute to enzymes inherent in the food of the animal. Dukes[2] accepts this statement in a summary of recent work on the physiology of digestion.

Schwartz and Rasp, estimating the diastatic value by the production of achroodextrin from starch, reported that rabbit saliva (quantity unstated) would hydrolyse 2 c.c. of a 1 per cent starch solution in times varying from 50 to 81 minutes with an average of 68 minutes. I have been able to obtain complete hydrolyses of the same volume of starch solution in times varying from 30 seconds to 7 minutes. This marked difference in results seems to arise from the method by which the saliva is obtained from the animal. Schwartz and Rasp procured the secretion by placing in the rabbit's mouth a small wad of cotton wool which absorbed any free saliva in the mouth cavity. This was then placed in the given quantity of starch solution. I have been able to obtain the saliva by a suction method directly from the mouth, the fluid being collected in a small glass vessel. In this way, up to 0·3 c.c. can be procured in 3–5 minutes. I have also demonstrated that by placing a shred of cotton wool in the saliva so obtained, its activity is very considerably impaired. The low diastatic activity observed by Schwartz and Rasp, then, seems to lie in the fact that the enzyme is readily adsorbed by the cotton wool and so removed from the sphere of activity.

Work is at present in progress to try to account for the marked fluctuations in reaction time observed with saliva obtained by the suction method.

Rabbit saliva, like human saliva, has no effect whatsoever on uncooked or unbroken starch grains, owing to the resistant sheath of amylopectin in which the individual grains are enclosed. Work done by Pozerski[3] (1927) suggests that only a very small percentage of the grains are broken in the process of mastication. This brings to light the rather interesting problem of the possible utility of the enzyme in rabbit's saliva.

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[1] C. Schwartz and F. Rasp, *Fermentforsch.*, **9**, p. 50 (1926).
[2] H. H. Dukes, *J. Amer. Vet. Assoc.*, ii, **30**, 225 (1930).
[3] E. Pozerski, *Compt. rend. Soc. Biol.*, 97 (35), 1592–4.

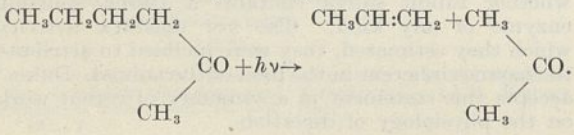
Photodecomposition of Aldehydes and Ketones

WE have recently extended our study of primary photochemical change by an investigation of the photodecomposition of the homologues of acetone in cyclohexane solution. It has been shown that in the gas phase there are two main types of decomposition. Type I occurs in short-chain aldehydes and ketones, and consists of an elimination of carbon monoxide, and the formation of an approximately equivalent amount of saturated hydrocarbon, resulting from the primary rupture of one of the carbonyl bonds; for example, in the case of acetone at 60° C. we have[1,2,3,4]:

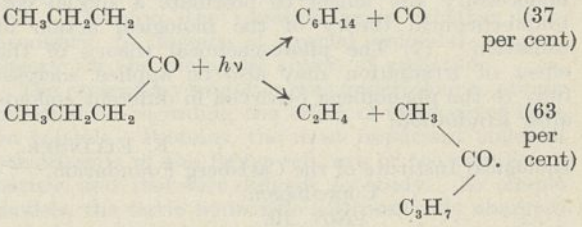
$$CH_3COCH_3 + h\nu \rightarrow CH_3CO + CH_3$$
$$CH_3CO \rightarrow CH_3 + CO$$
$$2CH_3 \rightarrow C_2H_6.$$

Type II, on the other hand, may be described as a species of cracking of the hydrocarbon chain in the $\alpha - \beta$ position to the carbonyl group, with the production of an olefine, and occurs increasingly with the higher homologues[2,5].

Thus with methyl-*n*-butyl ketone we have:



It has been shown that some carbonyl compounds in the gas phase decompose simultaneously in the two ways. This is the case with di-*n*-propyl ketone, in which both types have approximately equal probabilities of occurrence:



In solution and in the liquid state these results are considerably modified. Liquid acetone and acetone dissolved in benzene show no reaction whatever. In cyclohexane solution, however, as has been shown by Bowen[6], some reaction occurs with the solvent. Thus Type I decomposition is completely suppressed, and the excited molecules first formed must persist long enough to be deactivated by collision, or for reaction with the solvent.

With 10 per cent solutions of methyl-*n*-butyl ketone and di-*n*-propyl ketone in cyclohexane, however, at 20° C. we find a steady evolution of gas—practically pure propylene in the first case, and 98 per cent ethylene in the second, while in the irradiated solution of methyl-*n*-butyl ketone we have detected the presence of free acetone. It is therefore clear that while photodecomposition of Type I is almost completely suppressed, decomposition of Type II continues apparently unabated in solution. This is particularly apparent in the case of di-*n*-propyl ketone, in which both types occurred nearly equally in the gas phase.

At temperatures of *c.* 100° C., on the other hand, we have found that decomposition of Type I can also readily occur. For example, while pure liquid di-*n*-propyl ketone at 20° C. gives 98 per cent ethylene, at 90°–95° C. it gives a mixture consisting of *c.* 61 per cent ethylene, 30 per cent carbon monoxide and 9 per cent of ethane. At the same time the absolute amount of reaction according to Type II appears to be approximately independent of temperature.

It may be concluded from these results that:

(*a*) The mechanism of Type II decomposition is entirely separate from that of Type I.

(*b*) Molecules of the carbonyl substance can be activated in two alternate ways. In the first case (Type I), the excited molecule has a comparatively long life and is subject to strong deactivation by collision with the solvent, but the probability of reaction increases with temperature. In the second case (Type II), the time between excitation and reaction is so short as to be comparatively uninfluenced by the solvent molecules.

R. G. W. NORRISH.
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University Chemical Laboratory,
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Nov. 10.

[1] Norrish and Kirkbride, *J. Chem. Soc.*, 1518 (1932).
[2] Norrish and Appleyard, *J. Chem. Soc.*, 874 (1934).
[3] Norrish, Crone and Saltmarsh, *J. Chem. Soc.*, 1456 (1934).
[4] Spence and Wild, NATURE, **138**, 206 (1936).
[5] Bamford and Norrish, *J. Chem. Soc.*, 1504 (1935).
[6] Bowen, Communication to the Chemical Society (Nov. 5, 1936).

A Novel Interrelationship in the Triterpene Group

WE have elsewhere described the isolation of a diethenoid alcohol, $C_{30}H_{50}O$, accompanying β-amyrin and lupeol in the non-saponifiable fraction of shea nut oil[1]. We have now found that this alcohol, for which we propose the name basseol, is very readily cyclized by a variety of reagents to β-amyrin. This reaction is, we believe, the first example of the conversion of a naturally occurring tetracyclic triterpene to a likewise naturally occurring pentacyclic triterpene. It is of considerable biological importance in that it supplies an experimental realization of one stage in the natural evolution of a pentacyclic triterpene from presumably an acyclic structure of the squalene type by means of stepwise cyclizations.

A full account of this investigation will be published shortly.

J. H. BEYNON.
I. M. HEILBRON.
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University,
Manchester.
Nov. 19.

[1] Heilbron, Moffet and Spring, *J. Chem. Soc.*, 1583 (1934).

Radio Fadings and Bright Solar Eruptions

WITH reference to the three recent large sunspots reported in NATURE of December 5, p. 965, it is of interest to note that on December 3 a bright hydrogen eruption was observed at the Royal Observatory, Greenwich, to take place near one of them which was at the time 55° west of the sun's central meridian. The region in question was under observation with the spectrohelioscope (using the hydrogen line of the solar spectrum, $H\alpha$) at $11^h\ 46^m$ U.T., when a minor bright eruption was seen to be in progress. At $11^h\ 57^m$ a recrudescence of activity began, and by $12^h\ 03^m$ the bright hydrogen eruption had become as bright as the continuous spectrum 4A. from the centre of the $H\alpha$ line. At $12^h\ 18^m$, cloud unfortunately intervened, but from previous experience it is known that the average duration of the major bright eruptions is 30–45 minutes.

The chief interest of the present solar eruption is that a marked abnormality in the ionosphere affecting radio transmission was reported to the Royal Observatory as having occurred on the same day from $12^h\ 12^m$ until $12^h\ 42^m$.

In a memorandum issued by the Astronomer Royal on December 1, it is pointed out that, from a preliminary comparison of twenty-three marked radio fadings and bright solar eruptions recorded during the twelve months, July 1, 1935–June 30, 1936, eight radio fadings occurred during the actual observation of bright eruptions on the sun. In addition, two fadings occurred when a bright eruption was listed as having been seen some minutes later to be already in progress, although its time of origin was not observed owing to cloud or some other circumstance. Of the remaining thirteen radio fadings, in one case the sun was not under observation at the time, and in twelve cases it could not be ascertained from the international solar data (published in the Zurich solar *Bulletin*) whether any solar eruption was observed at the respective times—the sun being actually under observation—or whether, owing to cloud, observations were impossible.

The memorandum proceeds to point out that since nine or ten marked radio fadings were closely associated in time with bright solar eruptions (the expectation of chance coincidences being less than two, if solar eruptions of all intensities be considered and almost negligible if the proportion of the more intense solar eruptions, appropriate to the twenty-three radio fadings, be taken into account), a definite correlation is suggested between the two phenomena, the relationship appearing to depend on a rapid transmission of some solar agency travelling with a speed approaching that of light.

It is suggested that in future the published international solar data should be still further extended, so as to provide the additional information as to whether at the time of any marked radio fading the sun was actually under observation at one or more of the observatories equipped with spectroheliographs and spectrohelioscopes.

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Dec. 5.

Natural Selection

IN reply to Prof. MacBride's letter in NATURE of November 21, p. 884, may I just say that, both by my distinguished predecessor and myself, the study of as many specimens as possible has been recognized as of the first importance, and that is done not only at Oxford but also by visits to the British Museum (Natural History) and to Lord Rothschild's wonderful collection at Tring: indeed I was there yesterday.

The study of geographical variations, as we have so often emphasized, plays a leading part in the subject of mimicry; and, to paraphrase my friend's words, if he really wishes to know how the evolution of a mimetic pattern proceeded, let him come to the museum at Oxford. There he will see hundreds of *Papilio dardanus*, and all stages of evolution of the sundry mimetic tail-less forms of female from the tailed, male-like form.

I do not attempt to meet Prof. MacBride's arguments about mutations because, as I said in NATURE of October 17, they should be answered by more competent hands than mine.

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Nov. 28.

Professional Associations of Scientific Workers

THE leading article in the issue of NATURE dated November 14 directs attention to the limited scope of most professional associations of scientists and emphasizes the need for one which concerns itself with the social aspects of science. The Association of Scientific Workers has for many years tried to fulfil this function, as reference to its policy will show. "The main objects of the Association are to promote the interests of the Scientific Worker and to secure the wider application of science and scientific method for the welfare of society."

It must not be thought that the Association believes that society is likely to be ruled by 'technocrats' in this or any other country in the near future. Political power is wielded by dictators and by organized masses, but not by professional associations. Even so, as NATURE asserts, scientists have an important contribution to make to the government of our country, and the Parliamentary Science Committee is a live expression of the holding of this belief by many scientists. The Association has played a large part in the formation of this Committee, which now speaks on behalf of 100,000 supporters in its constituent bodies.

Attention to the influence of science in national affairs and its bearing on current legislation is one aspect of the Association's work. In its other functions it is more like other professional associations which dislike the name trades union; like both, it takes an active interest in the conditions of employment and security of tenure of scientific workers of all kinds—it has often been able to assist individual members in cases of unfair treatment. Because of the general character of the work done by the Association, we feel justified in seeking your courtesy in publication. At the same time, we wish to urge all who would see science properly applied to get in touch with the Association and either join it or give it financial support.

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Hon. General Secretary.

Association of Scientific Workers,
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Points from Foregoing Letters

DR. E. E. JELLEY finds that certain dyes exhibit a characteristic absorption spectrum associated with fluorescence of slightly longer wave-length, on precipitation from their solutions, before they become crystalline. He considers that they are then in a molecularly disperse state. The author describes the preparation of such disperse systems of a ψ-cyanine dye in both liquids and solids. They show an unusually narrow absorption and fluorescence band, analogous to that of the ruby.

Prof. G. Ingle Finch reports that whilst polished surfaces of single crystals of certain substances (quartz, diamond, sapphire) yield electron diffraction patterns of spots and lines characteristic of crystalline structure, polished surfaces of other crystals (zircon, tourmaline, cassiterite) give patterns of diffuse haloes typical of liquid mercury and various glasses. Etching removes the amorphous polished layer and restores the crystalline pattern. This, the author considers, supports Beilby's view of an amorphous layer of polish which, however, may afterwards recrystallize.

The mean free path of neutrons of 2·4 m.e.v. in paraffin wax is found by E. T. Booth and Dr. C. Hurst to be $4{\cdot}6 \pm 0{\cdot}9$ cm., which corresponds to a scattering cross-section of $1{\cdot}8 \times 10^{-24}$ cm.^{2}. This value together with the neutron-proton cross-sections found by other investigators, for neutrons of different energies, is compared with the theoretical scattering curve derived from Wigner's formula.

V. Fock finds a contradiction in Jordan's neutrino theory of light, owing to the linearity of the equations and the non-linearity of the connexion between F, the quantized wave function of the light field, and Ψ, that of the neutrino. He considers, moreover, that no consistent theory of light can be constructed based on a relation of F and Ψ.

A difficulty in Einstein's theory when applied to phenomena within material media is discussed by Dr. L. Silberstein. Both the minimal lines which represent laws of propagation of light, and the geodesics which give the motion of a free particle in a field, are applicable, according to Dr. Silberstein, only in the absence of matter.

Dr. A. C. Redfield states that a theory proposed by Rossby concerning the Gulf Stream and its associated counter currents provides a mechanism for the transport of water rich in organic nutrients from the depths of the Atlantic basin, on to the continental shelf of North America, thus accounting for the fertility of the water of this region.

Prof. F. G. Gregory and O. N. Purvis report that winter rye is not 'vernalized' at low temperature (1° C.) if oxygen is excluded; also that seeds can be 'devernalized' by keeping them at a temperature of 20° in nitrogen for a period equal to that which they have been exposed at the low temperature.

The effect of ultra-violet light upon the stability of several colloidal systems (sols of ferric hydroxide, mastic, etc.) has been investigated by F. Ellinger. The author enumerates some of the results obtained which, he considers, bear upon the question of whether a special colloid-chemical theory is necessary to explain the biological action of radiation.

The oxygen consumption of various species of mayfly nymphs has been studied by Prof. H. Munro Fox, C. A. Wingfield and B. G. Simmonds, in relation to the amount of oxygen in the water. In some species the oxygen intake does not diminish until the available oxygen has fallen to a very low value; in others it decreases as soon as the environmental oxygen drops. In the presence of more oxygen than is available normally in Nature, the oxygen intake of one species rises as high as 1½ times its normal value.

That the rabbit saliva has the power of changing (broken) starch grains to sugar is confirmed by I. M. Thomas. He states that Schwartz and Rasp had failed to prove this conclusively because they had used cotton wads to collect the saliva, with the result that the enzyme responsible for the hydrolysis of the starch was adsorbed and rendered ineffective.

The chemical action of light upon compounds belonging to the acetone series, in cyclohexane solution, is found by Dr. R. G. W. Norrish and C. H. Bamford to be of the 'cracking' type only (leading to the formation of unsaturated hydrocarbons like ethylene), while in the gaseous state the same compounds under the action of light yield, in addition, saturated hydrocarbons like methane. The authors suggest an interpretation of these results based upon the length of life of the 'excited' molecules.

Research Items

Palæolithic Site in Manchukuo

PALÆOLITHIC artefacts excavated at Ho-Chia-Kou in Ku-Hsiang-Tung in the environs of Harbin, Manchukuo, by the Japanese First Scientific Expedition to Manchukuo, 1933–34, have been described by Shigayasu Tokunaga and Nobuo Naora (Report: Section 6, Anthropology, Pt. 2. Waseda University, Tokyo). The deposits had been much eroded by river action, which had exposed clay, now being used for making bricks, and fossil mammalian remains. The site was excavated by members of the expedition in 1933 and 1934. At a depth of 1–3 m. below the surface were found numerous fossil mammalian and plant remains, as well as artefacts coeval with the fossil remains. This account deals only with the artefacts. A notable feature of the culture of the site is the great preponderance of bone artefacts; 262 artefacts were unearthed, of which 24 were stone, 217 bone, 4 horn, and 11 tusk. A large quantity of charcoal was found, which may have served for fuel. There were also hundreds of animal bone pieces. The types represented in the stone implements were the willow type, the triangular type and the scraper type. The workmanship is generally rough. Though there are indications that some of the implements may have been manufactured locally, there is no material available within fifty kilometres of Harbin. The implements resemble the Far Eastern series which has been found at the base of the loess at Ordos and Shansi, and belong to the culture of the Loess period, which Boule, Breuil and others regard as either Mousterian or Aurignacian. They are, however, decidedly oriental. The bone artefacts include sixteen forms, among which are spear-head shape, harpoon shape, chisel, chopper, bowl, spoon, arrow-head shape, axe, wedge, etc. There are edged tools made from an animal pelvis, and a bowl-shaped artefact made from a deer's cranium. The tusk implements are all of mammoth ivory. Several walnut fruits were found.

Physiological Effects of Pressure

A USEFUL review of the researches on the physiological effects of pressure is provided by McKeen Cattell (*Biol. Rev.*, Oct. 1936). It is restricted to hydrostatic pressure transmitted to a tissue or organism completely immersed. Pressure applied locally on a part or by means of a gas introduces further complications, and so is not considered. The principal effects are reduction in volume, alteration in the velocity of chemical reaction and changes in viscosity. Other effects include changes in solubility, ionic dissociation and surface tension. In view of the incompleteness of our knowledge, generalizations can scarcely be drawn. It does seem, however, that relatively small pressures speed up physiological processes, perhaps in part due to the fact that decrease in volume involves a diminution in the spaces between molecules and a consequent increase in the collision rate between the reactants. Higher pressures bring about depression of activities and finally an irreversible polymerization of proteins and allied substances, and also the inactivation enzymes, toxins, antibodies and viruses. There is apparently a pressure-time threshold varying widely with different tissues or organisms below which the changes induced by pressure are reversed with decompression but above which the changes are irreversible. It is suggested that pressure, because of the ease with which it can be applied and controlled, may be a valuable aid in attacking physiological problems.

Distribution of Coast Gorilla

IN describing four gorillas from the Sanga River region, collected by the George Vanderbilt African Expedition of 1934, Harold J. Coolidge, jun., discusses the question of the distribution of the species (*Proc. Acad. Nat. Sci. Philadelphia*, **88**, 479; 1936). In contrast to the opinion of Dr. A. H. Schulze, he regards the mountain gorilla as a race (*Gorilla gorilla beringeri*) distinct from the coast gorilla (*Gorilla gorilla*); and as collateral support of this point of view, he instances the discontinuous distribution of the two forms. There would appear to be a forest belt, 650 miles broad, stretching from long. 17° E., the eastern limit of the known range of the coast gorilla, and long. 28° E., the western limit of the mountain gorilla, in which gorillas are absent. For although various statements have been made of the presence of gorillas in this area, critical examination of the records shows that, with the exception of four skulls collected in 1908 from Bondo on the Uelle River, no great importance can be attached to the evidence. The lack of evidence is the more striking when account is taken of the fact that no record has been forthcoming during the last thirty-five years of active hunting and exploration in this part of the Congo.

Morphology of Coleoptera

IN the *Smithsonian Miscellaneous Collections*, **94**, No. 13 (1936) are two papers of special interest to students of this order of insects. Mr. W. H. Anderson, of the University of Maryland, contributes a comparative study of the labium in Coleopterous larvæ. In this paper special stress is laid upon the origins and insertions of the labial muscles and their importance in determining the homologies of the parts concerned. The composition of the labium is described in representatives of many of the more important families, and what is regarded as its typical formation is seen in the larvæ of *Byrrhus* and *Silpha*. The second paper is by Mr. Richard E. Blackwelder, of Stanford University, who discusses the adult morphology as displayed in the family Staphylinidæ. Practically all the exoskeletal parts are described and figured from representatives of ten out of the fifteen subfamilies. A comprehensive study within the limits of a single family, as in the present case, merits the attention of systematists as well as morphologists, and a number of anatomical parts are dealt with which present available characters of possible importance for taxonomic purposes. Both the above papers are well illustrated and provided with useful lists of the special literature concerned.

Genetical and Taxonomic Investigations in *Œnothera*

THE importance of combined cytological, ecological, genetical and taxonomic research is slowly but surely becoming recognized by botanists. A paper by Prof. R. Ruggles Gates in which field, cultural, and, to a less extent, laboratory investigations are combined, has recently appeared (*Phil. Trans. Roy. Soc. Lond.*, B, **226**, 239–355; 1936) and is doubly welcome for the results given and as a further example of improving taxonomic methods. The paper is concerned mainly with the results of field investigations of *Œnothera* populations made in eastern Canada in 1932, and with the detailed analysis of the cultures raised from the seeds collected. Seventeen new species and fifteen new varieties are fully and carefully described and figured. Valuable notes are given on the ecology, genetical peculiarities, behaviour under cultivation, and, for some of the cultures, the cytology. Such studies have enabled the author to indicate south to north movements in several different lines, epharmonic responses to environmental conditions, and evanescent characters which appear only during a part of the flowering season. That the catenation of all the plants dealt with in the paper and cytologically investigated was found to be, without exception, a ring of 14 chromosomes, may be considered further evidence that the genus *Œnothera* is cytologically exceptional among plants. Nevertheless, the suggestions made as to the causes of the polymorphism found in Eastern North America also apply, with certain modifications, to other genera. Gene mutations are said to have been active in supplying the raw materials for specific differentiation. Crossing has also probably played a part in increasing the number of specific types, the hybrids breeding true because of catenation. Such new 'constant' types are morphologically of equivalent value to the older species. Parallel mutations have also occurred many times in the different species.

Virus Diseases and Cytology

Two short papers by Dr. F. M. L. Sheffield (*Ann. App. Biol.*, **23**, 498 and 506; August 1936) consider the reactions of host-plant cells to attack by virus disease. The first paper confirms some earlier experiments by Prof. B. M. Duggar, that the spraying of virus extract upon an unwounded plant did not result in entrance of the virus. Actual injection of an infectious liquid into single cells only resulted in about ten per cent infection, thus suggesting that all cells of the host are not equally susceptible to virus attack. The second paper shows that virus does not produce inclusion bodies in the guard cells of a leaf of *Solanum nodiflorum*, though these bodies may appear in every cell over large areas of the epidermis. This fact has now been correlated with the absence of protoplasmic connexions between the epidermal and guard cells, thus providing circumstantial evidence that the spread of virus from cell to cell is along the plasmodesma.

Irish Fungi

DR. P. O'CONNOR has published a "Contribution to Knowledge of the Irish Fungi" (*Sci. Proc. Roy. Dub. Soc.*, **21**, No. 39; Sept. 1936). He has paid most attention to the rusts and smuts, the Ascomycetes, Phycomycetes and Fungi Imperfecti, but the Aphyllophorales, the Exobasidiales and Auriculariales of Rea's classification of the Basidiomycetes have also received attention. Nearly 350 species are recorded, frequently from numerous localities; the kind of spore produced by rust fungi is noted, and host plants are also listed. Several fungi are cited as new to the Irish flora, whilst *Cicinnobolus Plantaginis* on *Plantago maritima*, *Septoria Rubiae* on *Rubia peregrina*, *S. Saxifragæ* on *Saxifraga spathularis*, and *Rhabdospora lentiformis* on ash, are new to the fungus flora of the British Isles.

Alkaline Rocks of Chilwa, Southern Nyasaland

AT the meeting of the Geological Society of London on November 4, Dr. Frank Dixey delivered a lecture on the alkaline rocks occurring in the vicinity of Lake Chilwa. The types described comprise the following: syenite; volcanic vents infilled with carbonates and brecciated felspar-rock; hydrothermal rocks in the vents; nepheline-syenite; and swarms of associated dykes of sölvsbergite, microfoyaite, phonolite and nephelinite. The period of activity is ascribed to about the end of the Lias or not very long afterwards. The series thus represents a hitherto unrecognized phase of Karroo or early post-Karroo igneous activity. The felspathic materials of the vents include a unique rock-type containing 70–78·8 per cent of orthoclase, but with a potash content of 13 per cent—an amount which is even higher than is normally found in orthoclase itself. The gneisses and other rocks surrounding the vents are all altered, and sometimes they are thoroughly impregnated by the felspathic intrusive, with production of types comparable with Brögger's fenite-tveitâsite series (Fen Complex, Oslo District). The limestones of the Basement Complex in southern Nyasaland and the overlying younger limestones are of negligible bulk compared with the carbonate-rock of the vents and are also of different composition. The sedimentary or metamorphic limestones are accordingly rejected as a source of the carbonate-rock of the vents, which is regarded as of very deep-seated or even of magmatic origin. An account of Dr. Dixey's field work and that of C. B. Bisset, accompanied by the results of a petrographical investigation by W. Campbell Smith, will be published as a Bulletin of the Geological Survey of Nyasaland.

Temperature Measurements in Oil Wells

UNTIL recent years, systematic measurement of well temperatures has been impracticable owing to lack of a suitable instrument and technique. M. Schlumberger, H. G. Doll and A. A. Perebinossoff, in a paper presented for discussion at a meeting of the Institution of Petroleum Technologists on November 10, describe how these difficulties have been to a large extent overcome by the evolution of an extremely sensitive recording thermometer and technique for its operation. The instrument is capable of being run through all normal sizes of drill-pipe and tubing, has an accuracy of 0·1° C. and permits continuous logs to be traced at 15 cm. per sec. without noticeable time-lag. When run inside the well, it is in contact with the fluid contained therein and consequently measures the temperature of the fluid and not of the surrounding formations. It can be used in wells in thermal equilibrium with their surroundings and also in wells in thermal evolution with equally valuable results; also in both open and cased holes. Moreover, in a well where the exchange of surroundings is not limited to heat alone, it is capable of recording actual material flows of oil, gas or water into the well. The advantages of the instrument are,

therefore, obvious, but factors such as bottom-hole effect in drilling wells, size of the hole, nature of the fluid in the hole, etc., complicate interpretation of temperature diagrams. Close co-operation between a surveyor having experience of temperature measurement and a field staff familiar with local conditions is the prime necessity for accurate interpretation of temperature records, and only in this way can the maximum aid be drawn from them.

Production of Artificial Radioactivity by Deuterons

J. J. LIVINGOOD and J. J. Livingood and G. Seaborg have recently described the results of bombarding a number of heavier elements with 5-million volt deuterons from the Lawrence cyclotron accelerator (*Phys. Rev.*, **50**, 425; 1936). Zinc, antimony, ruthenium, bismuth, tin were bombarded with deuterons (currents up to 3·5 microamp.) and in every case β-radioactivity was produced. The complicated decay curves show that several radio-elements are formed in each case, and tentative nuclear reactions are suggested. In some cases the new active elements can be identified by comparison of their decay periods with those of the products of bombarding neighbouring elements with neutrons. In the case of tin, a chemical separation of indium, tin, antimony was made, and each of these was found to be associated with a characteristic activity. The case of bismuth is particularly interesting, since the product of the reaction

$$^{209}_{83}\mathrm{Bi} + ^{2}_{1}\mathrm{H} \rightarrow ^{210}_{83}\mathrm{Bi} + ^{1}_{1}\mathrm{H}$$

appears to be identical with the radium E of the natural radium series. It has the expected decay period, and it was possible to detect the α-particle activity of the polonium (radium F) formed by a successive transformation. The α-particles had the correct range. This is the first case of the synthesis of a naturally occurring radio-element.

Protium – Deuterium Ratio in Water

SEVERAL attempts have been made to determine the ratio protium – deuterium (^{1}H:^{2}H) in ordinary water, and the results mostly fall into two groups, either near 5500 or near 9000. The ratio has again been determined by a method which involves no extrapolation and in which the final value is approached from both the light and heavy side (N. F. Hall and T. O. Jones, *J. Amer. Chem. Soc.*, **58**, 1915; 1936). The authors believe that many of the discrepancies found rest upon inadequate correction for alteration in the oxygen isotope ratio (^{16}O:^{18}O) in the water used. They paid special attention to this. Surface water from a lake was freed from deuterium by repeated electrolysis with recombination of the electrolytic gases. When the *deficiency* in ^{18}O thus caused had been restored by carbon dioxide equilibrium against the original water, the density loss due to deuterium alone was 16·5 γ. The same water was electrolysed in stages and the electrolytic hydrogen burned in air. The *excess* of ^{18}O thus introduced was removed in the same way, and the density loss was again 16·5 γ. Control of oxygen isotope ratio was exercised by index of refraction measurements. With the value 1·1074 for the density at 25° of pure deuterium oxide (oxygen normalized) the protium – deuterium ratio in Lake Mendota (Madison, Wis.) surface water is calculated to be 6,400 ± 200, taking account of the non-additivity of volumes. This is in good agreement with G. N. Lewis's early estimate of 6,500. Using the ratio 6,400, Aston's recent determination of the physical atomic weights of the hydrogens, and the Mecke-Childs' conversion factor, the physical atomic weight of ordinary hydrogen becomes 1·0083 and the chemical value 1·0081.

Range of Loudspeakers

LOUDSPEAKERS are of value not only for domestic use with radio sets but also for other purposes. The paper on "The Appraisement of Loudspeakers" by F. H. Brittain, of the Research Laboratories of the General Electric Co., Ltd., the first half of which appeared in the *G.E.C. Journal* of November, is of both scientific and commercial value. Mr. Brittain begins by enumerating the common imperfections of electro-acoustic systems and then considers in detail the effect they have on the performance of loudspeakers used in connexion with domestic entertainment, with public entertainment such as talking films, etc., and with public address systems. If the sound originates in a studio, the sound waves of frequencies lying between 50 and 7,000 cycles are usually clearly transmitted. If the sound originates under less carefully controlled conditions, such as 'outside broadcasts', the frequency band may be much curtailed. In the case of reproduction from a gramophone record, the frequencies recorded lie between 200 and 6,000 cycles, after which there is a progressive reduction in output until about 40 cycles, when there is a complete cut-off. The frequency discrimination of radio receiving apparatus is nearly always well marked. When using broadcast receivers, owing to the closeness of adjacent stations, it is not usually possible to receive frequencies above about 7,000 cycles, and this is only attained under favourable conditions. At the low-frequency end the cost of the equipment at about 80 cycles makes it necessary to reduce the output. With the loudspeakers at present in use, the small size of the average table set makes reproduction of frequencies below 80 nearly impossible. Even with the latest sets fitted with special devices, the frequency band never exceeds about 10,000 cycles. Further causes of failure are described and the methods used for measuring them are indicated.

Changes in the Spectrum of the Star 25 Orionis

A STUDY of the spectrum of 25 Orionis by Helen Dodson (*Astrophys. J.*, **84**, 180) forms a useful contribution to the literature of bright-line stars. She has measured 147 spectrograms, covering the period 1915–33, and has found periodic variations in velocity (from both absorption and emission lines), line width, line contours, and line intensity ratios (V/R) for the double hydrogen emission lines. The velocity changes from the hydrogen lines are nearly synchronous with changes in the V/R ratio, but the period is not constant—having decreased from 1817 to 1025 days. The amplitude of velocity changes from individual hydrogen lines increases for the later members of the Balmer series; but the phase is the same for each, although the V/R ratio shows marked differences of phase from line to line. The helium lines are exceptionally interesting owing to the fact that their changes (in velocity and contour), while definitely related to the central hydrogen line velocities, are conspicuously out of phase with the latter. This is the only difficulty in accepting McLaughlin's hypothesis of a rotating, pulsating, nebulous atmosphere, which would account satisfactorily for all the remaining features of this and other similar bright-line stars.

Some Chemical Aspects of Nutrition

THE thirty-fifth Bedson Lecture was delivered by Prof. J. C. Drummond on November 20 at Armstrong College, Newcastle-on-Tyne, on "Chemical Aspects of some Modern Nutritional Problems".

Prof. Drummond pointed out that animals are dependent on plants for certain compounds which they cannot synthesize themselves from potentially suitable material. Such compounds can be divided into two types: tissue-building stores, and what might be termed 'chemical lubricants', for example, vitamins and hormones.

Cystine is a good example of the former type. Animals cannot synthesize this important amino-acid even if provided with sulphur, in various forms, and closely related compounds not containing sulphur, for example, serine. However, they can use menthionine, and dithioldilactic acid, but not homocystine and cystineamine to replace a cystine deficiency. Persons suffering from cystinuria who are given menthionine excrete it as cystine only.

Vitamins A, B_1, C and D are examples of the second type. In dealing with the work leading to the synthesis of vitamin B_1, Prof. Drummond pointed out that alteration in the position of the methyl group in the pyrimidine ring leads to the formation of biologically inactive products.

Vitamin A has been shown to be a C_{20} compound closely related to the carotinoid pigments. Those carotinoids possessing a β-ionone ring and a suitable side chain act as precursors of the vitamin. β-carotene itself is probably quantitatively converted into it. It is remarkable that the molecule divides at the central double bond considering that polyene chains are usually susceptible to oxidative attack at various points. Certain birds can use xanthophylls as vitamin A precursors, whereas other animals cannot. This suggests that there may be more than one vitamin A.

Chemical studies of vitamin C (*l*-ascorbic acid) are fairly complete, and it is interesting to compare the antiscorbutic activities of various substituted ascorbic acids. *d*-Ascorbic acid is quite inactive, *d*-arabo-ascorbic acid possesses one twentieth the activity, while *l*-rhamno-ascorbic acid and dehydro-ascorbic acid are less active. The preparation of these synthetic products possessing activity raises the question of the possibility of the synthesis of compounds of greater antiscorbutic power than vitamin C.

Turning to vitamin D (calciferol), Prof. Drummond said that it is generally held that rupture of one ring of its sterol precursor takes place during irradiation with ultra-violet light. Vitamin D activity is not dependent on the presence of a double bond in the side chain. Recent work on the antirachitic substance produced by irradiation of 7.dehydrocholesterol and on the products formed when 7.dehydrostigmasterol and 22.dihydro.7.dehydrostigmasterol are similarly treated was reviewed. The relation between constitution and biological action is not yet clearly apparent. There are two views to account for the activity of the various compounds. Either it is necessary to provide substances capable of being broken down to simpler molecules, or compounds with the same carbon skeleton as vitamin D are required. The former gleans some support from the fact that compounds, very different in structure from those obtained from natural sources, are capable of producing œstrus. For example, *l*-keto-tetrahydro phenanthrene and certain dibenzanthrone diols have some activity. A more remarkable case is that reported by Prof. E. C. Dodds, who found that dihydroxydiphenyl is active.

The Part played by Skin-Friction in Aeronautics*

THIS paper, running to some forty-seven pages of closely printed matter, is a book in itself. It is illustrated by twenty-seven figures, and is in five parts; Part I deals with resistance due to skin-friction, on an empirical basis, the determinations of Froude and of the many workers who followed him being presented in the form of a logarithmic diagram, in which, as is usual, ordinates give values of the constant C_0 (as in the expression $R = C_0 \rho V^2 \times 2a$) and abscissæ give Reynolds' numbers from 10^2 to 10^{10}; these numbers, denoted by the symbol N_R, cover the whole range from that proper to laminar flow, to that which obtains for ocean-going liners. The author points out that it is not possible to reconcile the wide variations in known data and gives a graph as indicating the probable minimum under ordinary average conditions. After a general discussion, an example is taken in the *Graf Zeppelin*; the hull resistance is calculated on the basis suggested by Froude in the case of ships; the horse-power is deduced for a flight speed of 80 m.p.h. and is in approximate agreement with that declared. A second example is given.

Parts II and III give in an abridged form the author's cyclic or vortex theory (sometimes referred to as the Prandtl theory) of sustentation, describing the two methods of treatment adopted by him in 1907 and 1914 respectively, and proving their quantitative identity. The criterion is shown to be the 'peripteral area' which defines the quantity of air handled by an aerofoil or the wings of a machine in flight. According to both methods the peripteral area is shown to be equal to 0·78 of the square of the span; that is to say, the area of a circle having a diameter equal to the span. From this the aerodynamic resistance may be calculated making use of the Newtonian principle of the equality of *force* and *momentum per second*. Parts II and III, though not directly concerned with skin-friction, lead up to Part IV, in which it is shown that the theory of

* Synopsis of a paper by Dr. F. W. Lanchester, F.R.S., read before the Royal Aeronautical Society on November 12.

sustentation has to be used in order to institute a comparison between theory and experiment. In Part II certain propositions which were first enunciated in the author's "Aerodynamics" are given.

Part IV, which contains the gist of the whole paper, is devoted to a comparison instituted between theory and recent data furnished by experiments conducted in the compressed air tunnel at the National Physical Laboratory (Aeronautical Research Committee: Reports and Memoranda, 1627). The essence of the matter is that prior to the installation of this tunnel, it was not possible to conduct wind channel experiments at high Reynolds' numbers such as apply in the case of full-scale machines, and it had long been known or at least suspected that there is a great difference between high and low Reynolds' numbers. The extent of the agreement (or disagreement) was a matter of conjecture. *It is demonstrated that complete reliance may be placed on the predictions of theory under conditions of high Reynolds' numbers.* The examples taken for the purpose of investigation are aerofoils R.A.F. 48, Clark *YH*, and Göttingen 387; the results are given tabulated and as plottings.

In Part V it is shown that in contrast to the agreement found over a range of high Reynolds' numbers (namely, about 2×10^6 and upwards) theory can no longer be considered reliable. For the full-scale glider or sail-plane where the Reynolds' number is in the region of $1{\cdot}7 \times 10^6$, agreement is still good, but when the same methods are applied to the investigation of model aerofoils and gliders the discrepancies are shown to be considerable. The reasons for this are discussed.

In the four appendixes the more important matters are: A relation is established between the gross weight of an aeroplane and the Reynolds' number; and three diagrams are given, by the aid of which the Reynolds' number may be ascertained prior to design, if the projected gross weight and the aspect ratio are given. In Appendix III reference is made to the region of instability or uncertainty in the relations of C_0 to the Reynolds' number, illustrated by plottings due to Mr. G. Baker (1915) and Prof. Melvile Jones (*Rep. and Mem.*, 1199). Appendix IV is devoted mainly to the aerodynamics of flying at high altitude.

A Magdalenian Site of Southern France: The Cave of Isturitz*

IN continuation of the exploration of the palæolithic cave of Isturitz (Basses Pyrénées) by Dr. R. de Saint-Périer, of which the Magdalenian levels in the Hall of St. Martin have already been described (*Arch. Inst. Pal. Hum. Mém.*, 7; 1930. See NATURE, **128**, 988; 1931), the Magdalenian deposits of the adjoining Great Hall, or Hall of Isturitz, as it has been named, have now been excavated; and it has become possible to take a general view of the Magdalenian culture of the site as a whole.

The Magdalenian deposits overlie Solutrean and Aurignacian levels, which are now being examined, without the intervention of any sterile layers. It is evident that both the Solutrean and the Magdalenian tribes established themselves here without any independent stratigraphic formation taking place. Both halls were occupied at the time the earliest Magdalenian deposits were laid down; but it is apparent that the occupation of the Great Hall was both longer and more intense than that of the Hall of St. Martin. Hearths, however, in the Great Hall are less frequent. A further difference is that while engraved plaques are exceptional in the Great Hall, though there art blossoms into great richness, in the Hall of St. Martin such plaques are numerous.

Although the age of the Magdalenian is that of the older Magdalenian of the Pyrenees, it is not, even at the base levels, the oldest stage of that culture. As is shown by the character of the lance-heads and certain of the engravings, these lower levels belong to Magdalenian iii, corresponding to Marsoulas. Above this is the culture of Magdalenian iv; but only in the Great Hall are found the harpoons, of which the evolved character points to a later occupation.

The most important period of occupation is Magdalenian iv, of which the chief characteristics are: a cold climate fauna, in which the horse is predominant, but a few retarded forms such as *Rhinoceros tichorhinus*, *Ursus spelæus* and *Hyæna crocuta* survive; and a lithic industry which is small and of mediocre execution, the various forms being not clearly defined and many implements being made from irregular and bad flakes. Burins are dominant. The bone industry is abundant, especially in the Great Hall. Many used bones show little sign of preparation for their purpose. The bone objects include needles, lance-heads of diverse types, *bâtons*, etc. A large number of the artefacts have been treated under a single classification as 'perforated'. The prototypes of harpoons found in the Great Hall already show signs of evolution.

The art forms of this period are here fully represented. They occur indiscriminately from bottom to top of the deposits of the period without distinction as to the level in which they are found. As already mentioned, the art of the Great Hall is richly developed both in the naturalistic form and in the conventionalized decorative motives. The naturalistic art in both sculpture and engraving shows remarkable powers of accurate observation of animal forms; while the conventionalized designs are clearly based on an equally accurate observation of the natural forms from which they are derived. One remarkable piece of engraving on bone represents a scene between a man and woman, of which the pose and composition depict graphically an expression of intense desire on the part of the male. The head of the woman and the lower part of the man are missing. The artist appears to have intended to represent the woman as thickly covered with hair over a great part of her body.

The abundance of the examples of this art in the Great Hall must account for the fact that, although much of it is of the highest quality, as a whole it is uneven and the choice of material is sometimes bad. The inferior may represent trial and practice pieces.

*Archives de l'Institut de Paléontologie Humaine. Mém. 17. La Grotte d'Isturitz. 2: Le Magdalénien de La Grande Salle. Par Dr. René de Saint-Périer. Pp. 140+12 plates. (Paris: Masson et Cie., 1936.) 120 fr.

In the levels of Magdalenian v and vi the climate is still cold; but the horse is less abundant. For a time the reindeer is important and then gives way to the deer. Birds become abundant. There is no very marked change in the character of the stone industry; the bone artefacts show a characteristic 'fossil' in the form of a staghorn point with a forked base; barbed harpoons appear. Objects of art become scarcer; sculpture disappears, and the art form is reduced to simple graving. Both realist and decorative art weaken and are less varied.

In the material of this level, the Azilians made their hearth. The stone industry above the Magdalenian levels resumes the forms of the Aurignacian culture with characteristic delicacy and beauty of retouch. Circular scrapers determine the Azilian character of the culture, their evidence being confirmed by the harpoons, which become more and more evolved.

With the close of this period man's occupation of the cave, save for burial purposes, comes to an end.

The British Institute of Radiology

Annual Congress and Exhibition

THE tenth Annual Congress and Exhibition of the British Institute of Radiology was held at the Central Hall, Westminster, on December 2–4, 1936. The arrangements differed to some extent from those of previous years, notably in the inclusion of a section of the exhibition devoted to physical research. Among the institutions represented in this section were St. Bartholomew's, the Royal Cancer and the Mount Vernon Hospitals, Radium Beam Therapy Research, and the National Physical Laboratory, while Dr. Russell Reynolds showed an X-ray cinematograph apparatus. The section showed clearly the close connexion between physical research, even modern atomic physics, and the medical applications of radiations of all types. The exhibit of radium beam therapy research was concerned with a study of induced radioactivity, the principal item being a Geiger counter connected to a cathode ray oscillograph, the screen of which is photographed on a 35 mm. ciné film operated by a mechanism so designed that the speed of motion of the film varies logarithmically with time. By the use of this device, the film moves quickly enough to record the rapid counts of a newly activated material but slows down as the activity decays, so that considerable economy in the cost of film results.

The Royal Cancer Hospital and the Mount Vernon Hospital had exhibits dealing with X-ray and radium dosage, their measurement and typical results. The apparatus used at the Royal Cancer Hospital to determine the gamma-ray output of radium in röntgens consists of accurately made air-wall ionization chambers connected to a Lindemann electrometer, while the Mount Vernon Hospital exhibit included a valve amplifier of the DuBridge type working in conjunction with air-wall chambers and used for exploring the fields round radium sources.

The St. Bartholomew's Hospital exhibit included a demonstration of a simple form of Geiger counter employing a neon lamp for measuring weak beams of gamma-rays and locating missing radium containers, and also a series of photographic films illustrating the paths of alpha- and beta-rays in celluloid and in photographic emulsions.

The National Physical Laboratory showed, *inter alia*, transparencies illustrating the apparatus used in the standardization of X-ray and gamma-ray dosemeters and in the testing of radium containers, sensitive dosemeters for the measurement of stray radiation, and various X-ray crystal photographs dealing with the structure of teeth, electro-plating, corrosion and fatigue in metals, etc. A further exhibit consisted of a model of a periscope for observing patients undergoing treatment with very penetrating radiations. The optical system comprises eight concave mirrors, but the system is so designed that, although the light beams fall on the mirrors at approximately 45° to their normals, there is negligible distortion and the image appears normal size and nearer to the observer than the object.

The X-ray cinematograph equipment shown employs an indirect method in which the image on a fluorescent screen is photographed on 35-mm. ciné film, which has an emulsion specially developed to have a high sensitivity to the light emitted by the screen. In order to reduce the strain on the apparatus and the X-ray tube, an ingenious switch is incorporated so that the tube is only excited during actual exposure. The ciné camera is of the conventional type, fitted with a special lens operating at $f0{\cdot}8$.

The session of the Congress devoted to physical and technical papers consisted in a symposium on "The Measurement of Ionization Current". Dr. D. E. Lea described a valve amplifier for the measurement of ionization currents which shares with the Townsend compensation method the advantage that the collecting electrode of the necessary ionization chamber is always substantially at earth potential. The ionization current is passed into a condenser connected to the grid of an electrometer triode the output of which is connected to two further stages of valve amplification, with the result that, in normal settings, a change of voltage of one millivolt on the grid of the electrometer valve brings about a change of voltage of ten volts in the output of the amplifier. The variation in the output voltage is thus sufficiently great to permit the operation of suitable relays and counting mechanisms through the intermediary of a thyratron. For the measurement of weak beams of radiations the rate of variation of the output voltage can be found over part of the full scale of the output voltmeter. By suitable adjustments the sensitivity of the instrument can be varied over a wide range.

Dr. G. W. C. Kaye, Mr. W. E. T. Perry and Mr. D. E. A. Jones described a ballistic amplifier in which troubles due to slow drifts and zero unsteadiness are avoided by isolating the detecting galvanometer from the anode circuit of the valve by the use of a blocking condenser. The apparatus may be used in two ways. In the first, the grid of the valve is

maintained at zero potential with respect to the filament by the operation of a suitable potentiometer, the balance being tested by short-circuiting the grid resistance. If the system is balanced, short-circuiting the resistance does not alter the grid potential and the (ballistic) galvanometer does not deflect. The second method depends on the fact that, with the system unbalanced, the magnitude of the ballistic throw is proportional to the ionization current and to the capacity of the blocking condenser.

Mr. T. B. Lane described a radiation integrator designed to measure the total quantity of radiation used in a given experiment. An ionization chamber is connected to the grid of an ordinary radio valve, in the output of which a thyratron is connected. The grid of the amplifying valve is given a considerable negative bias, which is reduced by the action of the ionization current until the valve operates the thyratron, which in turn operates a counting mechanism recording the number of units of charge liberated in the ionization chamber.

In closing the discussion, Prof. J. A. Crowther said he was inclined to doubt whether the various more or less elaborate amplifier and counting mechanisms in regular use to-day really do offer advantages over the older types of electrometer, which are inexpensive and reliable, and only have the disadvantage that their use requires some experimental skill.

The seventeenth Mackenzie Davidson Memorial Lecture was delivered by Dr. J. D. Cockcroft, on the subject of "High velocity positive ions. Their application to the transmutation of atomic nuclei and the production of artificial radioactivity". Dr. Cockcroft dealt with this subject in his usual lucid and fascinating manner, describing the early work on atomic transformations carried out with alpha-particles, the later work with canal rays, accelerated by potential differences of many hundreds of kilovolts, produced perhaps by the Van de Graaff static machine or the 'cyclotron' of Lawrence. Pointing out how, while earlier experiments only succeeded in transmuting light elements, a large number of heavy elements have now been transmuted, and in particular bismuth has been changed into radium E, having the same radioactive properties as the naturally occurring element. As an example of the biological significance of the effect, he mentioned the work of Hevesy, who, by injecting into plants and animals mixtures of ordinary phosphorus and radio-phosphorus, has been able, by means of Geiger counters and otherwise, to detect the movements of the phosphorus in the plant or animal and explore with some accuracy the distribution of the element at any time.

Educational Topics and Events

CAMBRIDGE.—Miss H. G. Wanklyn (Girton College) has been appointed University lecturer in the Department of Geography and Dr. S. R. Nockolds (Trinity College) University demonstrator in mineralogy and petrology.

OXFORD.—The electors to Dr. Lee's professorship of chemistry intend to proceed to the election of a successor to Prof. Frederick Soddy on January 16, 1937. It is the desire of the sub-faculty of chemistry that, if possible, a physical chemist be appointed. To this end some changes in the statute defining the duties of the new professor were proposed in Congregation on December 1 and after discussion carried. The main difficulty of the new proposal, brought out in the discussion, is that while the new professor is to be given the direction of both the Inorganic and the Physical Chemistry Departments, there is, in fact, at present no official University department of physical chemistry, the whole of the teaching, and much of the research, in this subject being done in college laboratories.

It is now settled that Lord Nuffield's benefaction of £2,000,000 to the medical school is to be paid in thirteen equal half-yearly instalments for the next six and a half years. Mr. W. M. Goodenough of the Radcliffe Hospital and Barclays Bank has been appointed chairman of the Trustees.

THE twenty-fifth Annual Conference of Educational Associations will be held at University College, London, W.C.1, on January 4–11, under the presidency of the Right Hon. W. Ormsby-Gore, whose presidential address entitled "Some Educational Problems of our Colonial Empire" will be delivered on January 5 at 5 p.m. On January 7 at 5 p.m., a joint conference on "Problems of Education within the Empire" will be held, when the speakers will include Sir Firoz Khan Moon, the High Commissioner for India, formerly Minister for Education in the Punjab; Dr. S. F. N. Gie, South African Minister in Berlin, formerly Secretary for Education, Union of South Africa; Prof. G. V. Portus, professor of political science and history, University of Adelaide; Prof. C. A. Krug, professor of education, Mount Allison University, New Brunswick; Prof. F. Clarke, director, Institute of Education, University of London. Further information can be obtained from the Conference Secretary, 29 Gordon Square, London, W.C.1.

THE Annual Conference of the Geographical Association will be held in the London School of Economics, Houghton Street, Aldwych, London, W.C.2, on January 5–7, under the presidency of Sir Josiah Stamp, whose address, "Geography and Economic Theory", will be delivered on January 7. A symposium on "Whither Population" will be held, when Prof. C. B. Fawcett, Dr. R. R. Kuczynski and Sir William Beveridge, among others, will speak. Among the lectures to be delivered will be one entitled "Problems of the North-East Coast", by G. H. J. Daysh, and one of the discussions announced is "Broadcast Geography Lessons" in which L. Brooks, Dr. H. Thomas, and others will speak. Further information can be obtained from the Secretary, Geographical Association, c/o Municipal High School of Commerce, Princess Street, Manchester, 1.

Science News a Century Ago

Lord John Russell and the University of London

The Times of December 13, 1836, contained a copy of the Charter of the University of London signed on November 28, together with the letter of Lord John Russell to the Earl of Burlington, dated December 1, and the Earl's reply dated December 9.

In his letter, Lord John Russell said: "I have the honour to transmit to your Lordship the charter of the University of London.

"His Majesty has been pleased to approve of the appointment of your Lordship as Chancellor, and of Mr. Lubbock as the first Vice-Chancellor of the University.

"I feel convinced that it is not necessary to recommend to your Lordship either a zealous attention to the interests of learning, or a constant regard to those principles of religious freedom, which have furnished motives for the Royal grant. . . .

"You may be assured that on my part also I shall esteem it an honour to co-operate in the advancement of an institution destined to confer the distinctions justly due to proficiency in literature, science or art, without imposing a test of religious opinions, or binding by the fetters of the 17th century the talent and merit of this present enlightened age."

Among the scientific men who composed the "one body politic and corporate" entrusted with the affairs of the University were Airy, Neil Arnott, Captain Beaufort, W. T. Brandl, Faraday, Prof. Henslow, Mark Roget, Sheepshanks, James Walker and many others eminent in medicine.

Opening of the London and Greenwich Railway

On December 14, 1836, the London and Greenwich Railway as far as Deptford was officially opened by the Lord Mayor of London amid great rejoicings. The construction of the long viaduct of brick arches had been regarded as a very great achievement. Engines had been at work on the line for some time, but on the day of the opening five trains travelled to and from London Bridge and Deptford. "Comparing the sensation which the traveller feels on this," said a writer in *The Times*, "as compared with other railroads, one may state, that owing, no doubt, to the fact that the whole road being over archways, there is a rumbling noise which is not heard on other roads. Much of this, however, is obviated by the construction of the carriages."

At a luncheon held at the Bridge-house Tavern in the afternoon, the Lord Mayor said: "The great object which the new railway would effect was that of economising time; the great characteristic of modern commercial life was the value set upon time." In their replies to the various toasts, the speakers referred to the gratifying prospects with which the railway commenced, the great benefits such undertakings conferred upon commerce and upon domestic trade and "the great accommodation which this individual channel of communication supplied to the City of London and the town of Greenwich".

The Optical Phenomena of Crystals

In a paper entitled "Further Observations on the Optical Phenomena of Crystals" read to the Royal Society on December 15, Henry Fox Talbot referred to the property of some crystals, similar to those possessed by the tourmaline, of analysing polarized light. If a drop of a solution of sulphate of chromium and potash in tartaric acid is placed on a plate of glass, evaporation soon yields filmy crystals which frequently have this property. The plumose crystals of boracic acid when crystallized from a solution of borax in phosphoric acid also possess this analytic power, and present very beautiful appearances when viewed with the polarizing microscope. Talbot said that he entertained the hope that it would be possible to obtain large and permanent crystals, which would possess the advantages of the tourmaline, without the inconvenience resulting from its dark colour.

Societies and Academies

Paris

Academy of Sciences, November 16 (*C.R.*, 203, 961–1036).

Emmanuel Leclainche: Notices on Sir Arnold Theiler and on Edoardo Perroncito.

Henri Douvillé: The shell of the lamellibranchs: its formation in *Ostrea edulis*.

Charles Goldziher: Logistic extension of the mortality formula of Makeham.

Bertrand Gambier: Surfaces of which the asymptotics of either system belong to linear complexes.

Paul Vincensini: Surfaces deformable with transformation of kinematically conjugated systems into conjugated systems.

Jean Dieudonné: Derivatives of rational fractions.

Pierre Humbert: The extension to prepotentials of Kelvin's theorem.

Sklenar: A new aviation motor.

Robert Esnault-Pelterie: Remarks on the preceding communication.

Jean Chazy: Advances of the node and perihelion of a planet under the action of a circular ring.

Bernard Kwal: Quantic mechanics and the principle of relativity.

Pierre Vernotte: The theoretical dimensions of the cellular vortices of Bénard.

Gaston Dupouy: The utilization of the ballistic galvanometer as a null instrument.

André Lallemand: The application to photography of a method allowing the energy of the photons to be amplified. The application of an electric field to accelerate the photo-electrons.

Ernest Esclangon: Remarks on the preceding note. The method is important astronomically, especially in the fields of photometry and spectroscopy.

Jacques Rabinovitch: The magnetic rotatory polarization and magnetic double refraction of solutions of β-naphthol and of β-methylnaphthalene.

Léon Capdecomme: An arrangement allowing the vertical illuminators of microscopes to transmit rectilinear polarized light of any azimuth.

Maurice Curie: Phosphorescent glass. The influence of crystallization. Two specimens of zinc borate containing a trace of manganese oxide were prepared, one almost wholly crystalline, the other vitreous. The crystalline specimen showed strong and durable phosphorescence, the vitreous specimen almost none.

Henri Guérin: The melting points and densities of the tribasic alkaline earth orthoarsenates.

Etienne Canals and Pierre Peyrot: The fluorescence of some pure substances. Nine highly purified hydrocarbons showed no trace of fluorescence. Of all the pure substances so far examined, only oxygen compounds are fluorescent.

Jean Bureau: The hydrated magnesium nitrites.

Pierre Süe: The constitution of the hydrated alkaline niobates.

André Michel: Study of the solid solutions of ferrous sulphide with sulphur, selenium and arsenic.

Hubert Forestier and Mlle. Myriam Graff: The reduction of boric anhydride by manganese. Manganese reduces boric anhydride at a temperature below 1,000° C. forming a ferromagnetic boride (MnB).

Roger Testut: The formation of chromium carbides. By heating chromium powder with excess of carbon, two definite carbides are obtained, Cr_3C_2

and Cr_5C_2. The excess of carbon can be removed by heating in oxygen at 900° C., since neither of these carbides is oxidized below 1,000° C.

CHARLES EMILE BRAZIER : The comparison of pyrheliometers. Two pyrheliometers measure the same physical magnitude only if, other things being equal, their apertures are exactly the same.

ROGER ULRICH : Correlation between the elongation of the fruit and the development of the seeds in the wallflower, *Cheiranthus Cheiri*. The length of the fruit is proportional to the number of seeds, and this is not due to any mechanical action of the young seeds, since there are frequently large intervals between the seeds. It would appear that the seeds in the course of development exercise a stimulating influence on the growth of the pericarp.

JEAN BEAUVERIE : Studies in experimental cytology : the chromoplasts of species of *Ranunculus*.

R. BRUNET and A. JULLIEN : The comparative architecture of the heart in some gastropod molluscs.

ROBERT WEILL : The existence of polypoid larvæ in the cycle of the Trachymedusa *Olindias phosphorica*.

PHILIPPE JOYET-LAVERGNE : Attempt at the valuation of the power of oxidation catalysis in the living cell. The reagent utilized for the study of oxidation processes in the living cell must fulfil two conditions ; it must penetrate the cell without causing injury, and the colour changes brought about by oxidation must be appreciable. Alkaline solutions of cobalt sulphate or chloride have been found to be suitable for this study.

PIERRE NICOLLE : Physiological variations of the reticulocytary proportion in the course of gestation, during lactation and after ablactation in the rabbit.

ALEXANDRE LIPSCHÜTZ : A typical and destructive growth of the uterine glands after experimental ovarian interventions.

BORIS EPHRUSSI and MORRIS HENRY HARNLY : The presence in different insects of substances intervening in the pigmentation of the eyes of *Drosophila melanogaster*.

DOMINGO MAURICIO GOMEZ : The physical characteristics of the vessels, circulatory yield and law of decrease as a function of time of the arterial pressure.

PAUL DURAND, PAUL GIROUD, EDOUARD LARRIVE and ANDRÉ MESTRALLET : Virulence of the fluids in the *maladie des porchers*.

Amsterdam

Royal Academy (*Proc.*, 39, No. 8, Oct. 1936).

L. S. ORNSTEIN : Scattering of neutrons in matter (2).

J. G. VAN DER CORPUT : Generalizations of Carleman's inequality.

F. M. JAEGER, J. A. BOTTEMA and E. ROSENBOHM : Exact measurement of the specific heats of metals at high temperatures. (26). Specific heats and the electrical resistance of cerium. *ibid.* (27). The specific heats and the electrical resistance of lanthanum.

A. H. BLAAUW, IDA LUYTEN and ANNIE M. HARTSEMA : The limits of the ability to flower and of the growth of the iris bulb (2*a*).

H. M. DE BURLET and A. KOOMAN : Manifestation of the duplex character of the semicircular canal system in the ontogenesis of the labyrinth of vertebrates.

O. POSTHUMUS : Affinities of the Osmundaceæ with *Grammatopteris* and *Asterochlænopsis* and with Zygopterideæ in general.

G. F. C. GRISS : The conformal differential invariants of a covariant symmetrical tensor of the fourth rank in the binary region.

J. A. BARRAU : Casts of points, rays and planes.

W. BLEEKER : Meteorological observations during the three Dutch Karakorum expeditions.

L. ALGERA : Influence of temperature treatment on carbohydrate metabolism, respiration and morphological development of the tulip (2).

M. A. VAN OVEREEM : A sampling apparatus for aeroplankton.

TAN SIN HOK : Contribution to our knowledge of the Lepidocyclinides.

G. H. R. VON KOENIGSWALD : First communication on a fossil hominid from the Early Pleistocene of East Java.

A. THIADENS : Rudistids from southern Santa Clara, Cuba.

J. ARIËNS KAPPERS : Brain – body weight relation in human ontogenesis and the *indice de valeur cérébrale* of Anthony and Coupin.

G. REVESZ : The psychoanalytical impulse theory. A discussion of Freud's work with an attempt to test its consequences and confront it with normal psychological experience and general biological facts.

Rome

Royal National Academy of the Lincei (*Atti*, 23, 459–536 ; 1936).

F. ENRIQUES : Characteristic property of irregular algebraic surfaces and infinitely close curves.

G. ABETTI : Height of the chromosphere in 1935 and the course of the solar cycle.

M. BETTI and E. LUCCHI : Anomalies in the dissociation constant of some halogenated organic acids.

G. ROVERETTO : Particular continental facies of the Ligurian Oligocene.

G. BARBA : Repetition of a class of functions.

S. CHERUBINO : Reduction of matrices to canonical form (1).

S. CINQUINI : Non-linear functional equations in the analytic field.

S. MINETTI : Holomorphous functions admitting of two exceptional finite values, and the behaviour of a holomorphous function in the neighbourhood of an isolated essential singular point (1).

L. TOSCANO : Powers of a matrix of the second order.

M. MANARINI : Vectorial homographies with kinematic applications in S_n spaces (1). Axials and dilatations.

C. TAGLIACOZZO : A theorem on elastic coactions.

P. CALOI : Two new types of seismic waves in the light of a theory of Somigliana.

G. GOIDÀNICH : A species of *Phytophthora* causing rotting of the collar in the tomato.

L. MAROTTA : Experiments with root apices isolated in culture.

G. BERGAMI : Liberation of a substance similar to acetylcholine from the cut surface of the nerve during physiological excitation.

G. PERETTI : Oxidation-reductions in the small intestine and in the liver of the albino rat during intestinal absorption.

V. ZAGAMI : Behaviour of the glycogen of the heart under the action of insulin.

A. GALAMINI : Contribution to the comparative study of anaphylaxis (1). Alimentary anaphylaxis and subdiaphragmatic vagotomy (2).

A. BASILE : Contribution to the study of the fine structure of striated muscular fibre under normal and pathological conditions (3). Regressive processes of the components of cross-striation.

Forthcoming Events

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

Monday, December 14

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Owen Lattimore: "The Mongol Landscape and People".

Tuesday, December 15

EUGENICS SOCIETY, at 5.15—(at the Linnean Society, Burlington House, London, W.1).—"Voluntary Sterilisation—the Work of the Past Year". Speakers: Wing-Commander A. W. H. James, M.P., Dr. Caroline Maule and J. Verney Quilliam.*

Wednesday, December 16

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. K. S. Sandford: "Recent Advances in the Knowledge of the Geology of Northern Central Africa".

ROYAL SOCIETY OF ARTS, at 8.—Sir William Bragg, F.R.S.: "The Development of Crystal Analysis" (Sir Henry Trueman Wood Memorial Lecture).

Friday, December 18

ROYAL INSTITUTION, at 9.—Lord Rayleigh, F.R.S.: "Optical Contact".

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1936; with Report of the Director of Fuel Research. Pp. x+217. (London: H.M. Stationery Office.) 4*s*. net. [2411

Index to Supplements to the Geographical Journal: Recent Geographical Literature Supplements, Vols. 1–4, Nos. 1–41, 1918–1932. Compiled by order of the Council. Edited by the Librarian. Pp. 470. (London: Royal Geographical Society; Edward Stanford, Ltd.) 16*s*.; to Fellows, 12*s*. [2511

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1698 (1956): Wind Tunnel Tests of the Characteristics of Wing Flaps and their Wakes. By K. W. Clark and F. W. Kirkby. Pp. 26. 3*s*. 6*d*. net. No. 1702 (1929): The Cowling of Cooling Systems. By R. S. Capon. Pp. 23. 3*s*. 6*d*. net. No. 1703 (1061): Full Scale Experiments at High Incidences with IIIF Seaplane. By A. E. Woodward Nutt. Pp. 22+2 plates. 3*s*. 6*d*. net. No. 1705 (1930): Variation of Exhaust Gas Temperature along the Tail Pipe of a Moth Aircraft, and the Effect of a Simple Silencer. By A. W. Morley. Pp. 9+2 plates. 2*s*. net. (London: H.M. Stationery Office.) [2511

Absorption of the Unemployed into Industry: Discussions between the Minister of Labour and Representatives of certain Industries. (Cmd. 5317.) Pp. 10. (London: H.M. Stationery Office.) 2*d*. net. [2711

Copper for Bus-Bar Purposes. (C.D.A. Publication No. 22, 1936.) Pp. vi+161+28 plates. (London: Copper Development Association.) [2711

Cinematograph Films Act, 1927. Report of a Committee appointed by the Board of Trade. (Cmd. 5320.) Pp. 41. (London: H.M. Stationery Office.) 9*d*. net. [3011

The British Institute of Radiology. Year Book, Session 1936–1937. Pp. 94. (London: British Institute of Radiology.) [3011

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology. No. 9: Further Studies on Transport in the Cotton Plant, VI: Interchange between the Tissues of the Corolla. By E. Phillis and T. G. Mason. Pp. 679–697. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*. [112

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Twenty-ninth Annual Report, 1935–36, presented by the Council to the Court of Governors on the 23rd October 1936. Pp. 47. (Cardiff: National Museum of Wales.) [112

The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Thirteenth Conference held at Balliol College, Oxford, September 18th to 21st, 1936. Pp. 136. (London: Association of Special Libraries and Information Bureaux.) 5*s*. [212

Other Countries

Industrial Research Bureau. Bulletin No. 1: Bibliography of Industrial Publications published in India from 1921. Pp. iii+257. 4.6 rupees; 7*s*. 3*d*. Bulletin No. 2: A Survey of the Indian Glass Industry. By E. Dixon. Pp. ix+39+9 plates. 14 annas; 1*s*. 6*d*. Bulletin No. 3: The Effects of Annealing Procedure on the Tensile Properties of Arsenical Copper Bar. By E. F. G. Gilmore. Pp. 11+3 plates. 8 annas; 10*d*. (Delhi: Manager of Publications.) [2311

Soölogiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 1, Stuk 3 en 4: The Endocranial Cast of the Florisbad Skull—a Correction; The Significance of the Bushman Skull. By Dr. T. F. Dreyer. Pp. ii+21–32. (Bloemfontein: Nasionale Museum.) [2411

Egyptian Government: Ministry of Public Works. Annual Report for 1924–1925. Part 1. Pp. xi+153. 20 P.T. Part 2. Pp. xi+236. 20 P.T. Annual Report for the Year 1925–1926. Part 1. Pp. xiii+178. 20 P.T. Part 2. Pp. xi+230. 20 P.T. Annual Report for the Year 1926–1927. Part 1. Pp. v+194. 20 P.T. Part 2. Pp. xii+236. 20 P.T. Annual Report for the Year 1927–1928. Part 1. Pp. vi+166. 20 P.T. Part 2. Pp. xiv+283. 20 P.T. (Cairo: Government Press.) [2411

U.S. Department of the Interior: Office of Education. Bulletin, 1936, No. 2: Young Children in European Countries in the Present Economic and Social Period. By Mary Dabney Davis. Pp. x+108. (Washington, D.C.: Government Printing Office.) 15 cents. [2411

Bulletin of the American Museum of Natural History. Vol. 70, Part 2: The Marine Fishes of West Africa, based on the Collection of the American Museum Congo Expedition, 1909–1915. By Henry W. Fowler. Pp. 607–1493. (New York: American Museum of Natural History.) [2611

Proceedings of the American Academy of Arts and Sciences. Vol. 71, No. 3: Ecological Relations of Ponerine and other Ants to Termites. By William Morton Wheeler. Pp. 159–244. 1.35 dollars. Vol. 71, No. 4: Uncertain Inference. By Ronald Aylmer Fisher. Pp. 245–258. 45 cents. Vol. 71, No. 5: The Respiratory Metabolism of the Chimpanzee. By John M. Bruton and Francis G. Benedict. Pp. 259–326. 1.20 dollars. (Boston, Mass.: American Academy of Arts and Sciences.) [2611

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 4: Studies in Tropical Fruits. 1: Preliminary Observations on some Aspects of Development, Ripening and Senescence, with Special Reference to Respiration; 2: Observations on Internal Gas Concentrations in Fruit. By C. W. Wardlaw and E. R. Leonard. Pp. 632–676. (Trinidad: Imperial College of Tropical Agriculture.) [2611

The Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 10: Diseases of Sugarcane and Methods for their Control. By L. S. Subramaniam. Pp. iv+31+ii+22 plates. (Delhi: Manager of Publications.) 1.14 rupees; 3*s*. 3*d*. [3011

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 21: A New Method and Apparatus for determining the Average Length and Fineness of Cotton Hairs. By Dr. Nazir Ahmad and C. Nanjundayya. Pp. 22. (Bombay: Indian Central Cotton Committee.) 8 annas. [3011

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 10 (Items 3042–3133): April, May, June 1936. By Ernest A. Hodgson. Pp. 195–216. 25 cents. No. 11 (Items 3134–3266): July, August, September 1936. By Ernest A. Hodgson. Pp. 217–238. 25 cents. (Ottawa: King's Printer.) [3011

Department of Commerce and Industries: Fisheries and Marine Biological Survey Division. Investigational Report No. 6: The Reproduction, Embryology and Metamorphosis of the Cape Crawfish (*Jasus lalandii*) (Milne Edwards) Ortmann. By Cecil Von Bonde. Pp. 25+12 plates. (Pretoria: Government Printer.) 1*s*. [112

Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band 71, Abh. 4: Zum Zodiakallicht-Problem. Von Hch. Meyer-Bührer. Pp. ii+71–118+17 plates. (Zürich: Gebrüder Fretz A.-G.) [112

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 38, Part 2: Der Einfluss der Eierbehandlung mit Zentrifugierung auf die Vererbung bei dem Seidenspinner, 1: Über experimentelle Auslösung der polyploiden Mutation, von Eisaku Kawaguchi; Artificial Insemination of *Bombyx mori*, by Seinosuke Ômura; Structure of the Testis and the Intratesticular Behaviour of the Spermatozoa, by Seinosuke Ômura. Pp. 111–181+3 plates. (Tokyo: Maruzen Co., Ltd.) [112

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademii i Oslo. Vol. 11, No. 3: Measuring of Auroræ with Very Long Base Lines. By Carl Størmer. Pp. 16+2 plates. 3.00 kr. Vol. 11, No. 5: Remarkable Aurora-Forms from Southern Norway. By Carl Størmer. Pp. 19+18 plates. 7.50 kr. (Oslo: Cammermeyers Boghandel.) [112

Field Museum of Natural History. Botany Leaflet No. 19: Old-fashioned Garden Flowers. By Donald Culross Peattie. Pp. 32. 25 cents. Geological Series, Vol. 6, No. 15: The Internal Structure of the Ear in some Notoungulates. By Bryan Patterson. Pp. 199–228. 40 cents. Technique Series, No. 4: Clearing and Staining Skeletons of Small Vertebrates. By D. Dwight Davis and U. R. Gore. Pp. 16. 35 cents. Zoological Series. Vol. 20, No. 15: The Distribution of Bidder's Organ in the Bufonidæ. By D. Dwight Davis. Pp. 115–126. 15 cents. Vol. 20, No. 16: Notes on Bahaman Reptiles and Amphibians. By Karl P. Schmidt. Pp. 127–134. 15 cents. Vol. 20, No. 17: Guatemalan Salamanders of the Genus Œdipus. By Karl P. Schmidt. Pp. 135–166. 50 cents. Vol. 20, No. 18: Notes on Snakes from Yucatan. By Karl P. Schmidt and E. Wyllys Andrews. Pp. 167–188. 25 cents. Vol. 20, No. 19: Preliminary Account of Coral Snakes of South America. By Karl P. Schmidt. Pp. 189–204. 15 cents. Vol. 20, No. 20: Notes on Central American and Mexican Coral Snakes. By Karl P. Schmidt. Pp. 205–216. 25 cents. Vol. 22, No. 2: Secondary Sex Characters of Chinese Frogs and Toads. By Ch'eng-Chao Liu. (Publication 368.) Pp. 113–156+12 plates. 50 cents. (Chicago: Field Museum of Natural History.) [312

Catalogues, etc.

A Selection of English Classics, Modern Bindings and New Books suitable for Presentation. Pp. 32. (London: Bernard Quaritch, Ltd.)

Diary for 1937. Pp. 32+32+32 maps+Diary. (Bonnybridge: John G. Stein and Co.)

Motion Picture Projection Lenses and Condensers. (Catalog E–16.) Pp. 16. (Rochester, N.Y.: Bausch and Lomb Optical Co.)

Books recently purchased at the disposal of the Library of the late Dr. J. A. Fuller-Maitland, consisting mainly of Poetry and Belles-Lettres, also an interesting collection of books about Eton College, and a number of volumes on Botany, Conchology, Entomology, Geology and Ornithology. (Catalogue No. 251.) Pp. 25. Books, Manuscripts, etc. (Catalogue No. 252.) Pp. 12. (London: Dulau and Co., Ltd.)