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## International Co-operation in Science

THE organization of international co-operation must in the nature of things be very different in different branches of science. Thus in astronomy, where no one country can cover the whole of the heavens or observe the sun continually through the twenty-four hours of the day, progress in many branches of statistical and even observational astronomy must depend on observers working in many countries of the globe on mutually agreed programmes. In geodesy the shape of the earth can only be determined with the highest possible accuracy by the survey of long arcs passing through a number of countries. Meteorology, geography and radio-science similarly present obvious examples where international agreements can alone secure the maximum of beneficial results from separate sets of observations and from instrumental and theoretical developments.

On the other hand, in sciences such as physics, chemistry and the biological sciences, where most developments come from the individual investigator and his team of co-workers, the value of international organization is less obvious, being limited at first sight to such important questions as the definition of standards or agreements on nomenclature. These have become the care of International Unions or International Congresses. The organized Union is to be preferred for such work to the Congress, as its framework is on the whole more suited to the maintenance of permanent committees. Both Unions and Congresses fulfil one further purpose of great value in bringing together periodically for discussion and mutual intercourse fellow-workers from many scattered lands, studying a group of cognate subjects. A similar service on a more limited scale is served by the gatherings of specialists in a given field of work held from time to time at various academic centres.

The International Council of Scientific Unions, heir to the old Association of Academies, serves as a link between the chief scientific bodies of the nations and also as a link between the various International Unions that adhere to it. One of its most useful tasks is to organize committees for the study of problems in which a number of Unions are interested: the Committee on Solar and Terrestrial Relationships examines just such a set of problems; the Unions of Astronomy, of Geodesy and Geophysics and of Radio-Science are all interested in its work and nominate members to serve on it.

The International Council may be said to approach the question of international co-operation from the side of the Unions. Another body, the Organisation Internationale de Co-opération Intellectuelle de la Société des Nations, working through its committee of scientific experts, has had quite another line of approach. It may be said to look at scientific questions from the points of view of those familiar with the problems that daily face the League of Nations. Thus the question of organizing help for scientific bodies of undoubted international value that for financial reasons find themselves unable to continue with their work comes naturally to the Organisation. Or again, the publication of important learned papers in languages not widely diffused in the world—a question of importance to scientific workers but not to them alone—has been studied by the Organisation, and a solution is more likely to be reached by the channels to which it has access than by individual Unions or Congresses or even the International Council. The same is true of the question of unauthorized translations of scientific work, and of the co-ordination of funds available in different countries for special

researches—a co-ordination necessary in order to avoid unnecessary or undesirable overlapping.

After some years of negotiations, the International Council of Scientific Unions and the Organisation Internationale de Co-operation Intellectuelle have come to an agreement to work together in the several tasks which they face—not as one body but as two bodies in close touch with each other. Last month, in Paris, at a joint meeting of the two bodies (see *NATURE*, July 17, p. 121), Prof. Ch. Fabry and Sir Gilbert Murray signed an agreement which lays down the method of co-operation of the two bodies, the respective spheres of action being broadly along the lines indicated above. Purely scientific questions will go to the Council, which will work through its constituent Unions: questions of a primarily international nature will be referred to the Organisation. At a recent meeting of the General Assembly of the International Council a proposal

was made for the appointment of a committee on the relation of science to the life of the community. It was pointed out that in its original form this motion covered a field lying beyond the purview of the Council. In the amended form which was adopted, the work of the Committee, which has now been appointed (see p. 358), was limited to the scientific side of the question. The more political side may be taken up elsewhere, and represents the kind of question that may fall to the Organisation to study.

There remain gaps on both sides. Subjects—geology and mathematics may be mentioned—lie outside the range covered by the Council; countries stand aloof from the League of Nations. Still, the *rapprochement* between the two bodies can but strengthen both and may lead to more active co-operation between them and those other bodies which stay outside, though each is carrying out work of similar purpose in its own branch of science.

## Native Science in Southern Sudan

### Witchcraft, Oracles and Magic among the Azande

By Dr. E. E. Evans-Pritchard. Pp. xxx + 558 + 34 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 21s. net.

DR. E. E. EVANS-PRITCHARD, already well known in anthropological circles for some penetrating studies of the manners, customs and mental constitution of certain peoples of the Anglo-Egyptian Sudan, has by this book placed himself in the front rank of British anthropologists. Europeans who have visited primitive people have always been attracted by the notions which they think they have found concerning witchcraft, oracles and magic; but most of them have attempted to interpret these notions mainly in the light of their own, or what they consider to be their own, habits of thought. Consequently, these topics have been treated as if their main interest lay in their curiosity, their oddity; and not infrequently they have been taken to indicate that there is some sort of primitive logic exceedingly different from that of the Western world. Dr. Evans-Pritchard is no mere curiosity hunter; he realizes that many of the Azande notions about witchcraft, and the ways in which the people use them, are not far removed from some of our own current ideas and practices about medicine and the chances of life; and he knows perfectly well that

though his book is entirely concerned with witches, witch-doctors, magicians and sorcerers, it covers only a very small part of Azande activity: "Most of their talk is common-sense talk, and their references to witchcraft, whilst frequent enough, bear no comparison in volume to their talk about other matters".

The Azande are a fairly numerous people living on the Nile-Congo divide. At present they form a homogeneous group, but they were formerly of many different tribes, with a variety of languages and institutions. As is natural, in such circumstances differences of social status play a great part in Zande culture. In particular, while the general rank and file are easily accessible, sociable, good-natured, assimilative, the royal class remain aloof, conservative, superior.

"Every Zande is an authority on witchcraft." If anything unusual happens, especially anything of an unfortunate character, it is attributed to some person—less often to some animal—in whom witchcraft resides as an inherent quality. This person does not need to do anything special in order to exert his influence; in fact, he cannot well help himself, for within him, whether he knows it or not, is some "witchcraft substance". Dr. Evans-Pritchard has himself never seen this substance, but it can be discovered by autopsy, and the evidence leads him to believe that it is the small intestine at a certain phase of digestive process.



Anyway, whatever it is, it is hereditary, and since it is a part of the body, it grows with the body, and becomes more potent as its possessor grows older. It can threaten misfortune, and then may be counteracted in various ways through the co-operation of oracles. It may produce death, and then must be avenged, though very little appears to be known about the precise operation of vengeance-magic.

In the early parts of his book, Dr. Evans-Pritchard describes, with copious illustration, what witchcraft is to the Azande, what sorts of things it can do, and what socially controlled processes there are for taking precautions against its more disastrous effects. It provides for these natives a kind of "natural philosophy by which the relations between men and unfortunate events are explained", and it gives them a "ready and stereotyped means of reacting to such events". So there is no kind of contradiction if a man treats a festering wound as due to witchcraft, and at the same time treats the wound as due to a spear or a splinter. Equally there is no contradiction if he should say that a death is caused by a weapon in some particular place, and at the same time by witchcraft in some other place. A good many Europeans have wished to verbalize all these actions or attitudes, and then to show that the different statements made together are mutually incompatible, and to prove from this that the native mind works in some manner peculiar to itself. But Dr. Evans-Pritchard puts the truth perfectly clearly: "We have to be careful to avoid in the absence of native dogma constructing a dogma which we would formulate were we to act as the Azande do. . . . The Zande actualizes his beliefs rather than intellectualizes them, and his tenets are expressed in socially controlled behaviour rather than in doctrines. . . . His ideas are imprisoned in action and cannot be cited to explain and justify action".

A person who is in a line of witches is probably inhabited by witchcraft; but he need not worry overmuch about that. Anybody can be a witch, and so he can live comfortably, respected, and even somewhat admired by his neighbours. A Zande who is worried about his health will go off to consult an oracle in the socially approved way. He may be a little downcast until he has taken the necessary steps to render the witchcraft quiet, but this is unlikely to carry him into downright illness. Also, contrary to the sort of opinion which has been expressed in some quarters, these people, at any rate, are no more likely to be thrown into a variety of mental disorders by their beliefs about ubiquitous witches than are most people in our own community when they read newspaper reports of road-accident statistics. The Zande, indeed, "is

never so happy as when he is consulting the poison oracle, and he easily banishes all other considerations from his mind when he is engaged upon this task of supreme interest". For him it is clearly as good as a visit to Harley Street is for many of us. Dr. Evans-Pritchard shows, moreover, the social value of many of the controlled methods for the consultation of oracles, as well as of the ways in which such practices may be abused. Destroyed for ever, in this case, at any rate, is the picture that when a people talk often about witchcraft and its potency for misfortune, they must be miserable, hag-ridden, harried and hunted by malevolent forces. They can be as curious, and, in their ways, as knowledgeable as anybody, about the sequences of natural events; and, when they come to the other questions about why certain sequences happen when they happen, they can get from their witch philosophy the same sort of satisfaction that others find in 'chance', or 'probability', or in different beliefs more dogmatically formulated.

In Part 2 of his book Dr. Evans-Pritchard considers witch-doctors; that is to say, the specialized profession among the Azande who have "vested interests in the knowledge of medicines" and are consulted when witchcraft is suspected. The witch-doctor is a diviner, exposing witches, and a magician, thwarting them. Here, if possible, the book becomes more interesting still. The topics discussed are: how the witch-doctor conducts his *séance*, what is the basis of Azande belief in the witch-doctor, how the novice is trained in the art, and the place of the witch-doctor in Zande society. The accounts of the technique of the doctor, of how he maintains his social prestige, of the ways in which he elicits just the sort of information which his vocation requires, of the skill with which he often meets individual desire and need and satisfies important social demands are both convincing and delightful to read. Anyone who has talked with witch-doctors in an African community, as I have done, and watched them at work, will be interested to find that Dr. Evans-Pritchard was "impressed with their ability" and that he thinks it probable "that as a rule men who show a strong desire to become witch-doctors have a higher degree of intellectual curiosity and greater social ambition than the ordinary Zande possesses". In view especially of the great amount of administrative trouble which has arisen in many parts of the British Empire owing to the adoption of purely repressive measures against the diviner and magician, it is particularly to be hoped that people responsible, directly or indirectly, for the government of native races will read and seriously consider this part of the book.

Dr. Evans-Pritchard next discusses various practices connected with oracles, their collection



and use, and deals finally with magic and sorcery, with some comments also upon native leechcraft. It appears that of late a number of associations have developed among the Azande for the practice of magic in assemblies. One of these is described in considerable detail, and it is demonstrated how a specific organization may be used to introduce new ideas and to spread them throughout the community, although the ideas themselves may have a much wider application than the avowed purpose of the organization would seem to imply.

Dr. Evans-Pritchard modestly hopes that his book will "be of service to political officers, doctors, and missionaries in Zandeland, and later to Azande themselves". If they will read it, it certainly will be of service to all of these; but it will also be of

wider value than this. Every social anthropologist should study it, not only for the wealth of information which it contains, but also as a model of well-controlled and sane methods of investigation. Everybody interested in the development of primitive science and the ways in which other minds than our own attempt to explain natural processes should read it, for it will correct a mass of popular and third-hand speculation concerning these matters. Further, everybody who is practically interested in native administration anywhere throughout the British Dominions ought to read it, for it will help him to understand the core of many difficult administrative problems and to solve them with a minimum of disastrous friction.

F. C. BARTLETT.

## Chemical Stabilization

### The Retardation of Chemical Reactions

By Prof. Kenneth C. Bailey. Pp. viii + 479. (London: Edward Arnold and Co., 1937.) 26s. net.

THE problem of the supply of drinking water to troops sent to tropical stations was extremely difficult during the early part of the Great War. For removing the excess of chlorine used in sterilizing water, hydrated sodium sulphite was dispatched to places like Basra, Bagdad, etc., where the temperature goes up to 118° F. (48° C.) in the shade in summer. It frequently happened that by the time the sodium sulphite reached its destination, it was wholly converted by oxidation into sodium sulphate, which was useless as an 'antichlor'. Hence investigations were carried on to discover stabilizing agents or retarders of the oxidation by air of sodium sulphite. Hydroquinone (quinol) and other organic compounds when added even in traces were effective in preserving sodium sulphite from such oxidation.

Sodium sulphite, which is a valuable material in photography as well, and other useful substances like vitamins, butter, fats, cod liver oil, rubber, petrol, ether, chloroform, hydrogen peroxide, acrolein, and so on, are stabilized on a commercial scale against oxidation, polymerization, decomposition, etc., by the addition of chemicals, which in general can themselves combine with oxygen. The use of acrolein as a poison gas led the late Prof. Moureu and Prof. Dufraisse to study its stabilization by different reagents.

Not only is the subject of importance to chemists and industrialists, but physiologists also know that fats and especially carbohydrates act as protein

economizers in the animal body. Moreover, carbohydrates, pentosans, cellulosic materials, etc., when added to soil, cause nitrogen fixation and also preserve the soil nitrogen from too rapid oxidation and loss.

Prof. K. C. Bailey has collected the literature on the subject and has ably discussed it from the theoretical and practical points of view. After a brief account of the historical development, the author takes up the oxidation of phosphorus and the combination of hydrogen and oxygen. A number of retarders for both these reactions have been known for some time. He considers the mechanism of these oxidations from the point of view of the chain theory and goes on next to the oxidation of hydrocarbons and other compounds. This is followed by an excellent account of the work of Moureu and Dufraisse, who have given a great impetus to research in the retardation of oxidations. The slowing down of the oxidations of inorganic substances like sulphites, arsenites, antimonites, ferrous, stannous, cuprous salts and organic compounds like aldehydes, chloroform and other halogenated substances, adrenaline, carbohydrates and allied compounds, dyestuffs, etc., has also been discussed. It is interesting to note that the rancidity of butter, cod liver oil and similar substances is chiefly due to their partial oxidation by air, and many reducing agents such as hydroquinone and pyrogallol even in traces retard this oxidation and delay rancidity.

In recent years, 'anti-knock' compounds and their function in motor-car engines have been extensively studied, and Prof. Bailey has given an adequate account of this work with the various theories that have been put forward to account



for it. Existing theories appear to be inadequate, and further work is necessary.

The protection of rubber from deterioration, the preservation of hydrogen peroxide from decomposition and the prevention of metallic corrosion are also considered in this book. The function of retarders in the setting of plaster-of-Paris and cement is also discussed.

In the last portion, the decomposition of numerous organic and inorganic compounds, the reactions of halogens with hydrogen and other reducing agents and the retardation by water in the processes of esterification, saponification,

hydrolysis and the decomposition of organic substances by concentrated sulphuric acid, have been summarized. A brief account of the quenching of fluorescence and the after-glow of active nitrogen has also been included. There is a bibliography of 1,630 original papers at the end of the book.

The subject-matter of this book is of considerable practical and theoretical importance. Prof. Bailey's discussion of the diverse topics involved is clear and exhaustive, and presented in a very readable form. The book should be valued and widely read.

N. R. DHAR.

## Reflections on Life

### Life Here and Now :

Conclusions Derived from an Examination of the Sense of Duration. By Arthur Ponsonby (Lord Ponsonby of Shulbrede.) Pp. 289. (London : George Allen and Unwin, Ltd., 1936.) 10s. 6d. net.

THIS rather unusual book of reflections on life not only gives us in effect an interesting portrait of one of our greatest authorities on the type of data which characterize the 'commonplace book', but also an unexpected plea for individual action in support of high ideals, whether of peace or of social reform. Lord Ponsonby has long been occupied with thought on the nature of time and on our appreciation of its meaning and value in the art of living. He now advances a general argument based on an analysis of the sense of duration, and relying on the scientific attitude of Huxley's generation, he tilts valiantly at organized religion as he conceives it. The idea of personal immortality is challenged, and its rejection appears to be inspired largely by his contention that too much time is occupied in vain speculations about the future to the neglect of the present.

If Lord Ponsonby appears to overstress the logical part of man's nature, there is nothing in this finely written plea for more effective use of the immediate moment to control the duration of our living which can possibly impede that *rap-prochement* between science and religion for which Smuts and others have been pleading. Not even those whose convictions he brushes on one side—not always on the most convincing grounds—can fail to recognize the dignity and sincerity of his plea for a better use of our present term, of the proper use of the new in the here, of the moment as it passes in our own environment. He gives us wise words on the small matters which make up the art of

living, but most will welcome the book for its inspiring idealism. Planning the future, he claims, is better for the mind than analysing the past, and if he is impatient with creeds it is perhaps mainly in so far as they impede progress.

Lord Ponsonby believes in individuality, and nowhere is this clearer than in his plea for a courageous stand for peace. "Our forefathers certainly would be unable to discover any element of glory in modern warfare; but they would observe in the world a noticeable depreciation of the value of human life." The warm human sympathies of the writer are as conspicuous as the sincerity of his thought and the lucidity of his diction, and they lead him to a final plea for action and service which is poles asunder from the frenzied plea of the demagogue to "do something". Its calm and dignified courage should win the sympathy of all who appreciate the inspiring personality imprinted upon that plea: "Now is the greatest of moments, the most real thing of which we can be aware. . . . To seize it as an opportunity means bracing ourselves up for action, decision, bite, endeavour . . . not vague resolutions but insistent occupation, not irresolute hopes but intent purposes, not languid aspirations but ready service, not 'Time will tell', but 'I will tell Time' . . . the errors of impetuosity are far less serious than the errors of caution and indolence and the enervating paralysis of procrastination. . . . There is no failure except in leaving off trying."

These are no pages from a dilettante's notebook, but a glimpse into the soul of one who has made time his servant, and himself compelled the hours to suit his intentions, the minutes to serve his purpose.

R. BRIGHTMAN.



## Trade Marks in India

The Law of Trade and Merchandise Marks in India

By Dr. S. Venkateswaran. Pp. lxxx+767. (Madras : Madras Law Journal Office, Mylapore ; Calcutta : Law Book Co., 1937.) 20 rupees.

THE year in which an amending Trade Marks Bill is passing through Parliament in England is singularly appropriate for the appearance of a book on trade marks in India. The book is not only in itself an excellent and comprehensive guide to English trade mark law, but is also a most powerful argument for the trade mark legislation in India that its author desires. The position to-day in India is very much the same as it was in England before 1875 ; the owner of a trade mark can only attempt to protect his rights by a cumbrous passing-off action or by invoking the Indian Merchandise Marks Act, under which the onus is on him to prove his entitlement, and a successful action can give him neither damages nor an injunction.

Simplicity and a reasonable degree of certainty can only be attained by direct trade mark legislation, for which there has been a demand since 1877. Mr. Venkateswaran, the author of the work under notice, an examiner in the Indian Patent Office, has a melancholy tale to tell of the abortive efforts that have been made to secure such legislation. Agreement on the need has not been accompanied by agreement on the method, and India, unable to join the International Union for the Protection of Industrial Property, by reason of the absence of trade mark legislation, has only privately run registers to show as the result of sixty years of persuasion, petition and argument by chambers of commerce and other interested bodies in India and the United Kingdom.

One of the great difficulties about trade marks is to be found in the fact that they are dealt with in most countries by the same Government department that handles patents. This encourages the idea that the two forms of protection are closely parallel. In fact, patents and trade marks have considerable fundamental differences, which were not clearly realized, for example, in the United States, for the greater part of the nineteenth century. The delay in getting adequate legislation in India will be regarded less harshly when it is realized that, in the United States, Thomas Jefferson was recommending trade mark legislation so early as 1791, and not until 1905 was there water-tight legislation there, a first Act of 1870

having been declared, *more Americano*, unconstitutional.

Mr. Venkateswaran, who is completely up to date, has a good deal to say about the Goschen Committee on Trade Marks, the report of which, issued in 1934, forms the basis for the English Trade Marks Bill. He is not only in favour of Indian trade mark law following the British model in general but also advises, with a varying degree of insistence, the adoption of most of the recommendations of the Committee. He approves, for example, of assignment in gross, but is doubtful of the applicability of Clause 8 to India, feeling that, in her present state of industrialization, abuse might arise there if the names of "registered users" as well as those of the actual proprietors could be entered on the register. Nor is he altogether happy about the marks, introduced in England in 1905 and used to indicate certification by some competent authority of the origin, material, accuracy, etc., of goods so certified. On one point, the division of the Trade Mark register into Part A and Part B, he advises a clean breakaway from English practice. He feels that the effective demand for Part B is relatively small in Great Britain, and in India can be ignored. But he goes further and states that the difference between the requirements for the two parts is neither clear nor well-explained by the English courts, and refers in support to Mr. Justice Romer's remarks in the "Liverpool Cables" case to the effect that it was doubtful whether there was any difference between "adapted to distinguish" and "capable of distinguishing", and that if a mark did in fact distinguish, it should be adapted to distinguish.

Cotton marks, for very obvious reasons, are of the first importance to India, and Mr. Venkateswaran has very definite views about the shape that relevant Indian legislation should take. He would allow the registration of word marks for cotton goods but not that of line headings. He quotes with approval in connexion with word marks some of the rules of the Bombay Mill Owners' Association, which has a register of trade names, but suggests that the exclusion of the names of gods, goddesses and mythological persons from this private register is definitely on the harsh side and sets an example not to be followed when an official register is set up.

There should be no disagreement about the need for trade marks legislation in India, and there should be the minimum of discussion before it is decided that the legislation must be on a purely



Federal and not on a States basis, the experience of the United States alone being quite sufficient to make a decision in favour of a strictly central system inevitable. Sufficient has been said, however, to show that there will be considerable debate on detail and even on certain major points of principle before trade mark India leaves the 'law-less' company of Monaco, Sarawak and the Solomon Islands and is able to take her place as a full member of the International Union.

When active consideration of prospective legislation for India does take place, it is inconceivable that Mr. Venkateswaran should not be called into consultation, for his book shows him to have both a masterly grasp of principle and a keen perception of detail. Sir Courtney Terrell, chief Justice of the Patna High Court, says in an introduction to the book that it astonished him to find "that legal

principles should be so admirably expounded by one who is not a professional lawyer" and reinforces from his wide experience at home and in India the author's demand for action to end the chaos that exists in a country where no action for infringement of a trade mark can lie and the actual form of action possible—and the decision—may vary from one provincial court to another.

In a work which was merely an industrious compilation, the fact that there were some two thousand five hundred actions listed in the table of cases would normally go to show the practitioner that the book was worth acquiring. It is mentioned here only to indicate that though Mr. Venkateswaran has produced a powerful large-scale propaganda document, he has at the same time written a first-class text-book very suitable for the Indian and far from being unsuitable for the English student.

## A Survey of Psychopathology

### Modern Discoveries in Medical Psychology

By Dr. Clifford Allen. Pp. x+280. (London: Macmillan and Co., Ltd., 1937.) 8s. 6d. net.

DR. CLIFFORD ALLEN gives a general survey of the recent history of psychopathology suited for the medical man or the intelligent layman. He rehabilitates Mesmer as an honest worker whose results, though given a wrong explanation, were nevertheless worthy of that investigation which was denied them. He might have shown the parallel between Mesmer and Charcot, for the latter's results were genuine but misunderstood phenomena, the anatomical nervous system taking the place of Mesmer's magnetism in a spurious explanation.

Janet's work, with his theory of dissociation of consciousness, prepared the path for Freud, and to this period belong Morton Prince's studies of multiple personality. The description of the gradual nature of Freud's discoveries helps to their understanding, though the necessary condensation of material does rather less than justice to this important stage of development. Dr. Allen defends the use of what he perhaps wrongly calls mechanistic devices and mental mechanisms, by which he means those theoretical constructions giving a spatial and dynamic view of mental processes. One might, however, object to the personification by which the superego "can still wreak its revenge on the patient by making him have a terrible sense of guilt, and sometimes compel him to do something for self-punishment".

The author is fair towards Adler's theories, but, like everyone with practical experience of analytical procedure, finds them incomplete and unsatisfying, though clinically useful because of their easier demands and avoidance of emphasis upon sexuality. Jung receives credit for his work on psychological types, but the author accuses him of spoiling the technique of Freud "by the addition of a hotch-potch of religion and mythology which cannot act in any other manner than as suggestion".

Kretschmer and Pavlov are adequately handled, but only one phrase (on p. 277) indicates that Pavlov is by some people placed in opposition to Freud, and regarded, indeed, as having made psychology unnecessary. This opposition can be understood only by a knowledge of the historical conflicts in medicine between animists and vitalists on one side and iatro-physicists on the other, which form a continuous series with present controversies and depend not upon knowledge but upon basic differences of outlook. This is a field of interest that Dr. Clifford Allen has not approached.

The author's aim of presenting current views is efficiently carried out, but a unifying summary of the position to-day would have been welcome. There is fortunately among the younger generation of psychiatrists and psychotherapists an agreement upon certain fundamental principles which the author's scheme of presentation cannot convey to the reader. His literary style is straightforward and simple, and he has made the subject intelligible without shirking its difficulties.

M. C.



**A Text Book of Trigonometry :**  
for Colleges and Engineering Schools. By William H. H. Cowles and James E. Thompson. Pp. x+373. (London : Chapman and Hall, Ltd., 1936.) 12s. 6d. net.

So many books on trigonometry are published that, when a new one makes its appearance, especial characteristics are naturally looked for. The present volume is much larger than usual, but it surveys a wider field as the course is intended to be a preparation for the study of higher mathematics, physical science and engineering. The authors state that several new and unique features are developed in the presentation of the subject, and this claim is well substantiated, for the fundamental principles of trigonometry are not dealt with in a piecemeal fashion so common in many books. Circular functions are, for example, defined generally at the beginning ; radian measure, too, is introduced at once and used throughout the course. The discussion of complex numbers, expansions in series and general analytical trigonometry is not only thoroughly sound, but also is more interesting and complete than is usual. Two chapters are devoted to the manifold applications of the subject to surveying, mechanics, geodesy and astronomy. Instructive chapters are also given on logarithmic computation and the use of the slide rule, whilst emphasis is rightly laid upon accuracy, precision and significant figures in all numerical work. Considerable attention is also directed to the analysis of problems and the reduction of the formulæ deduced to a suitable form for numerical evaluation.

The student is provided with a large number of varied exercises to which answers are supplied, and some very useful tables are given at the end. The book is certainly well adapted to the purpose for which it was written, and reveals that trigonometry is something far more interesting than the mere solution of plane triangles.

F. G. W. B.

**Moeurs et coutumes des indiens sauvages de l'Amérique du sud**  
Par Marquis de Wavrin. (Bibliothèque scientifique.) Pp. 656+16 plates. (Paris : Payot et Cie, 1937.) 60 francs.

In this impressive work of more than six hundred closely printed pages, the Marquis de Wavrin has embodied the results of fifteen years of travel and observation on five journeys of exploration among the less-known Indians of South America. He has covered a wide territory, for there is scarcely a part of the continent which he has not visited in that period ; but his most entertaining and informative (in the anthropological sense) material is drawn from the various peoples of the Amazonian region. His method is anecdotal rather than systematic, except that he has classified his data into chapters according to subject, covering material culture, social organization, relations of the sexes, religious beliefs and folklore.

Although amusing and instructive enough to read, the unfortunate lack of method, by which the data

from widely separated tribes are massed together without order or discrimination, makes it a source book for the delver after facts, rather than an ethnographical treatise. This is especially to be regretted as the author is an acute and careful observer. Perhaps he will conform to the suggestion made by M. de Créqui-Montfort in the preface, and produce a more formal account of his results later.

**Thermodynamic Theory of Affinity :**  
a Book of Principles. By Prof. Th. De Donder and Prof. Pierre Van Rysselberghe. Pp. xx+142. (Stanford University, Calif. ; Stanford University Press ; London : Oxford University Press, 1936.) 13s. 6d. net.

THEORIES of affinity have interested physical chemists for a considerable time ; moreover, greater recognition is now being given to such concepts as aids in the interpretation of experimental results.

The book now before us represents an essentially synthetic outlook, and the introduction of the terms "uncompensated heat" and "degree of advancement of a reaction" gives the basis upon which it is written. The former expression is simply the  $dQ'$  of Clausius under a slightly new guise, the latter ( $\xi$ ), however, is decidedly interesting as representing the state of a chemical system ; its time-derivative is a rate, which leads at once to a criterion of equilibrium. These two quantities are combined in the fundamental hypothesis that  $dQ'/d\xi$  is independent of any particular relation between the pressure, temperature and "degree of advancement" during a reaction. A detailed analysis leads the authors to identify this coefficient with the affinity.

In general, the treatment developed in these pages is suitable for obtaining straightforward solutions to problems like Le Chatelier's principle ; another volume is promised, to deal with applications and numerical examples.

F. I. G. R.

**Freud and Marx :**  
a Dialectical Study. By R. Osborn. Pp. 285. (London : Victor Gollancz, Ltd., 1937.) 8s. 6d. net.

In this comparative study—the first of its kind to be undertaken—the author emphasizes the importance of a closer study of psycho-analysis by Marxists, of Marxism by psycho-analysts and of both by the general public. He maintains that as psycho-analysis teaches us to recognize that unconscious motives are at work in us all, the curriculum of the Marxist should include a study of the unconscious mind, both Freud and Marx being pioneers in revolutionary psychological discoveries.

The work contains a study of the relationship between Freudian and Marxist theories regarding primitive society, the materialistic conception of history, religion and dialectical materialism. In conclusion, the author declares that "the Marxist without knowing something of the subjective side of man's life will remain one-sided, as will the Freudian who misconceives the objective situation in which man's subjective life expresses itself".



## Physical Investigations on Falling Snow\*

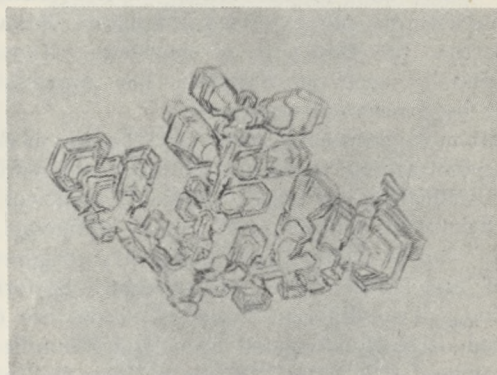
[In this article I have used the nomenclature with which I have endeavoured to standardize the English names of the various snow forms. Prof. U. Nakaya, who had not seen my work when preparing his papers, has now agreed to follow this, except that he proposes to continue to call a particle of falling snow a "snow crystal" in preference to my "snowflake". As all snow, whether falling or having lain on the ground for months, is crystalline, the word "snow crystal" is likely to lead to ambiguity. I admit that "snowflake" ("simple" for a single crystal; "compound" for an assemblage) is not perfect, but until a better word is devised it must, I fear, remain.—G. S.]

THE researches which form the subject of this article were carried out by Nakaya and his assistants at Sapporo and Mt. Tokati in the island of Hokkaido, the most northerly member of the Japanese archipelago. Ukitirō Nakaya, who is professor of physics at the Hokkaido Imperial University, has been studying the general subject for many years, but the special work of which the results are now given was done during the winters of 1933–35.

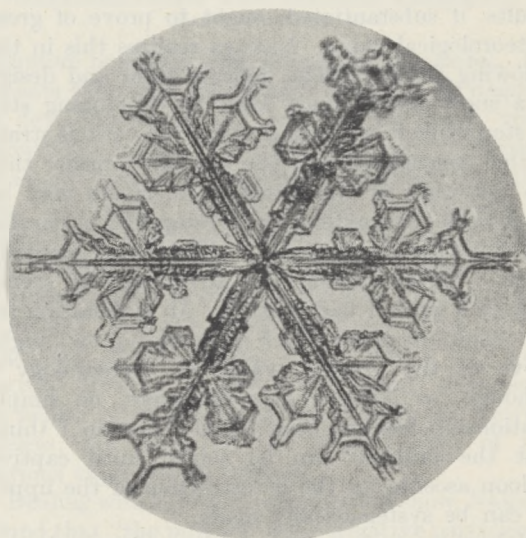
Nakaya commences his researches with a preliminary examination of the problem of snowflake structure in an attempt to find a method of classification for the many varying types, and of ascribing to each the conditions favouring its development. He wonders at the marvellously symmetrical form of the dendritic branches of a flake. "There is apparently no reason for a twig . . . to grow from one main branch when a corresponding twig happens to extend from another main branch. . . . We must suppose the existence of some means which informs other branches of the occurrence of a twig on a point of one branch." He suggests, but with doubt, the possibility of a bud of the twig causing a distortion of the lattice, which is transmitted to the other branches.

It seems simpler, however, to believe that, as I have suggested elsewhere, "changes in the scheme of ornamentation are caused by the flake passing

through different temperature and concentration gradients"<sup>1</sup>, and clearly each portion of the flake would normally come under these changes at the same instant and so symmetrical growth would be promoted.



(a) FROST CRYSTALS (photograph by Mr. Hatakeyama).



(b) CORRESPONDING SNOWFLAKE (photograph by U. Nakaya). MAGNIFICATION, 21.

Fig. 1.

One of the most important features of Nakaya's work was the designing of an apparatus for making hoar and rime under controlled conditions of temperature and humidity. Both these forms, incidentally, are crystalline, and I must respectfully join issue with Prof. Nakaya in his statement that rime, which consists of frozen water droplets, is amorphous. Previous to this he had shown that

\* Based on a series of eight papers by Prof. U. Nakaya and his assistants, published in the *Journal of the Faculty of Science, Hokkaido Imperial University*, under the following titles:

(1) "Snow Crystals observed in 1933 at Sapporo and some Relations with Meteorological Conditions" (ii, 1, No. 5, Feb. 1934).

(2) "Classification and Explanation of Snow Crystals observed in the Winter of 1933–34 at Mt. Tokati and at Sapporo" (ii, 1, No. 6, Dec. 1934).

(3) "On the Electrical Nature of Snow Particles" (ii, 1, No. 6, Dec. 1934).

(4) "Simultaneous Observations of the Mass, Falling Velocity and Form of Individual Snow Crystals" (ii, 1, No. 7, Oct. 1935).

(5) "On the Correspondence of Snow and Rime Crystals" (ii, 1, No. 7, Oct. 1935).

(6) "On the Artificial Production of Frost Crystals, with reference to the Mechanism of Formation of Snow Crystals" (ii, 1, No. 7, Oct. 1935).

(7) "Notes on Irregular Snow Crystals and Snow Pellets" (ii, 1, No. 8, April 1936).

(8) "General Classification of Snow Crystals and their Frequency of Occurrence" (ii, 1, No. 9, Dec. 1936).



hoar crystals (which result from the sublimation of water vapour upon fixed objects as opposed to the moving nuclei of snowflakes) correspond in form with the flakes. In other words, we get needle, plate and dendritic forms of hoar just as we do of the snowflake (see Fig. 1). Arguing by analogy, he assumes the following facts for snow: that at the highest supersaturation the needle type develops, next the dendritic, then an 'intermediate' form, then the plate, the pyramidal, the prism, in that order, and, at the lowest supersaturation, prisms with one side extended in a plane. Nakaya notes that this rare type of snowflake, although occasionally seen at Sapporo, has apparently never been recorded elsewhere.

The most surprising result is that the needle and prism appear to occupy different ends of the scale, indicating not merely different conditions of formation but perhaps even a basic difference in type. This is, I think, quite contrary to general belief, and further proof will no doubt be forthcoming. Two different types of needle are described—a single elongated form, and a bundle of thin pillars. The latter, Nakaya believes, indicates the advent of warmer conditions.

Full justice cannot be done to this line of research in the confines of a brief account, but its results, if substantiated, ought to prove of great meteorological value. Nakaya realizes this in the following words: "The delicate form and design of a snow crystal must form by developing step by step while it is falling through the various strata of the atmosphere, and the authors consider that the structure of the atmospheric layers may be inferred to some extent by investigating in parallel the structure of snowflakes." With this I cordially agree; before having the advantage of seeing Nakaya's work, I had written, "An elaboration [of the conditions under which snowflakes grow] might prove of the greatest value to meteorology"<sup>2</sup>, although, as Nakaya says elsewhere, no simple relationship has yet been found; nor do I think that the problem can be solved until captive balloon ascents for the investigation of the upper air can be systematically made.

Nakaya's views on the subject of irregular or malformed snowflakes are most stimulating. Although stressing the exquisite symmetry of ordinary snowflakes, he points out that absolute and complete symmetry is never in fact attained, and that complete malformations are far more common than previous writers, Bentley for example, have led us to believe. Nakaya describes, *inter alia*, flakes deformed by the subsequent attachment of a second nucleus on which further growth takes place. Other deformations are, he says, due to the supply of water vapour from a 'one-sided direction', due, I imagine, to the flake

falling irregularly. These irregular crystals are observed to fall in great frequency for a few minutes and then cease entirely. From this Nakaya has been led to think that these irregularities are not merely chance occurrences, but are caused by definite and, ultimately perhaps, ascertainable causes. I suggest that another factor may be responsible for the malformation of snowflakes. Dewar showed that electrical stimuli have a strong accelerating influence on the sublimation of water vapour. Is it not possible that these in some way, as, for example, by the sudden advent of a new electrical charge, might cause irregular growth?

Nakaya also states that "a snowfall usually consisted of several types of snow and sometimes almost all types of flake were found in a single snowfall. Occasionally only dendritic plane flakes were observed at a given moment. These would continue for a short time, and then another type would begin to mix with them; after some time, a third type would take its place, and so on". A graphic table shows these happenings in detail. The investigator everywhere emphasizes that his results are those found in Hokkaido only. I have, however, on many occasions observed this sequence of types in the Alps.

Nakaya commences the paper which deals with the classification of snowflakes, and which gives the impression of being the *raison d'être* of these researches, with notes on previous classifications such as those of Nordenskiöld, Hellmann and Pernter, which divided the flakes into plates, columns and their combinations. Humphreys added triangular plates and twelve-sided plates. "These classifications," Nakaya writes, "are inclined to attach too much importance to the regular crystals or the simpler form. The feature of the present classification is that we regard all the flake types as of equal importance, such as irregular [plane] crystals and those consisting of a spatial assemblage of plane branches, both of which are, as a matter of fact, no less frequently observed among the natural snow crystals." This last point, which I have italicized, is stressed throughout Nakaya's work.

#### THE GENERAL CLASSIFICATION OF SNOW CRYSTALS

(In this case Nakaya's nomenclature has remained unaltered. *Graupel* is, of course, our soft hail.)

- I. Needle crystal.
  - (1) Simple needle.
  - (2) Combination of needles.
- II. Columnar crystal.
  - (1) Simple column.
    - (a) Pyramid.
    - (b) Bullet type.
    - (c) Hexagonal column.
  - (2) Combination of columns.
    - (a) Combination of bullet crystals.
    - (b) Assemblage of short columns.



- III. Plane crystal.
  - (1) Regular crystals developed in one plane.
    - (a) Stellar form.
    - (b) Plane dendritic form.
    - (c) Crystal of areal extensions.
    - (d) Plate.
    - (e) Plate with extensions at corners.
    - (f) Stellar crystal with plates at the ends of branches.
  - (2) Crystal developed from two nuclei.
  - (3) Malformed crystal.
  - (4) Spatial assemblage of plane branches, with a stellar base.
  - (5) Spatial assemblage of plane branches, radiating type.
- IV. Combination of column and plane crystals.
  - (1) Column with plane crystals.
  - (2) Twelve-sided crystal.
  - (3) Combination of bullets with plane crystals.
- V. Columnar crystal with extended side planes.
- VI. Crystal with cloud particles and *Graupel*.
  - (1) Crystal with droplets.
  - (2) Thick plate.
  - (3) *Graupel*-like snow.
  - (4) *Graupel*.
- VII. Amorphous snow particle.

What Nakaya terms a "bullet" is very much like the cup crystals so often found in hoar deposits, but never hitherto recorded in falling snow<sup>3</sup>. I also suggest that the "amorphous snow" consists, in reality, of wind-comminuted snow particles. Nakaya is able to confirm the belief that columnar crystals fall when the upper air temperature is low, but states, as I have always maintained, that temperatures at the surface have little or no bearing on this.

This classification—or perhaps it should be called grouping—will probably in time give place to one based on more essential crystallographic factors, and even, perhaps, on varying internal structures of the ice, but it certainly goes further,

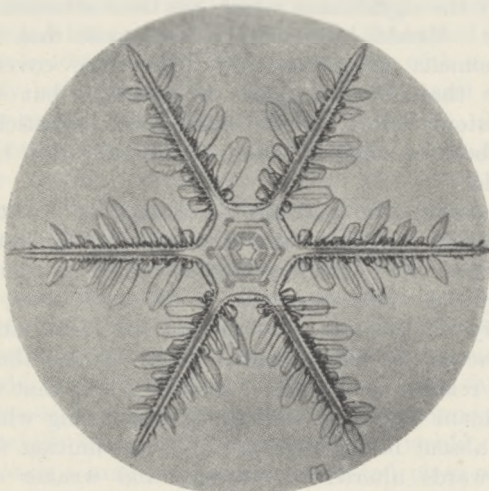


Fig. 2.

PLANE DENDRITIC SNOWFLAKE. MAGNIFICATION, 27.5.

and gives us a far better idea of the problem, than any that have preceded it.

Among what might be called the by-products of the researches the following point is of special interest, namely, that the mean thickness of a large number of dendritic flakes measured is

$0.011 \pm 0.0015$  mm. and is remarkably constant, the smallest being 0.009 mm. and the largest 0.015, although the diameters of the flakes measured varied from 2.35 mm. to 5.0 mm.

On the subject of the formation of soft hail, Nakaya found that it has a very low density, and



Fig. 3.

HEXAGONAL PLATE WITH DENDRITIC EXTENSIONS. MAGNIFICATION, 36.2.

therefore possesses large interstitial air spaces. He repeats the fairly well-known fact that all degrees of development of soft hail can be found, from snowflakes decked with a few frozen cloud-droplets to assemblages of ice pearls entirely hiding the flake. The satisfactory theory of the development of conical soft hail units put forth by Prof. Köhler<sup>4</sup> had probably not been seen by Prof. Nakaya.

Some space is devoted to the sizes of snowflakes. I believe, however, that conditions often favour continued growth during travel over a very long vertical distance, so that size is largely dependent on length of travel and is thus fortuitous. Nevertheless, the notes on the relative sizes of the various types are interesting.

Dealing with the electrical nature of snow, Nakaya found that "the number of the negative particles in general far exceeded that of the positive, being 63% of the total 1474 particles observed". When (frozen) water droplets were attached to the particles, the charge was predominantly positive.

Referring to the subject of the fall of individual flakes in relation to their mass and shape, a series of averages is tabulated as follows :

	Diameter (mm.)	Mass (mgm.)	Velocity (cm./sec.)	Ratio of velocity to that of corresponding rain-drop <sup>a</sup>
Needle	1.53	0.004	50	1/2
Plane dendritic	3.26	0.043	31	1/6
Spatial dendritic	4.15	0.146	57	1/5
Sundry small flakes	2.15	0.064	50	1/4
Flake with droplets	2.45	0.176	100	1/5
Soft hail	2.13	0.80	180	1/2.5



Each of the eight papers is illustrated with carefully captioned photomicrographs, from which those in this article have been reproduced. Nakaya's technique of photographing snowflakes is exquisite and far superior to any that I have seen. While following the general method employed by W. A. Bentley, he gains both in accuracy and, incidentally, in artistic effect by not trimming the margins of the flakes, and by reproducing the photographs on a light instead of a dark background. Remarkable and beautiful as was Bentley's work<sup>6</sup>, its re-publication has lost in scientific value by the omission of the degree of magnification and of meteorological conditions obtaining at the time of the collection of the flakes. Nakaya's work is a continuation of and improvement on Bentley's.

What we must now hope is that Prof. Nakaya

will continue his researches. Some of his results are only tentative, and some of his later work admittedly negatives his earlier, so that a summarized version of the results of the whole eight papers in the light of his most recent experiments would add greatly to their value. Be all that as it may, there is no doubt that the work in total adds very considerably to our knowledge of the nature of falling snow. G. SELIGMAN.

<sup>1</sup> "Snow Structure and Ski Fields", p. 36 (Macmillan, 1936).

<sup>2</sup> *ibid.*, p. 40.

<sup>3</sup> Nakaya has since written that this form is a modification of the hollow cup crystal.

<sup>4</sup> Studien über die Nebelfrostablagerungen auf dem Partotjikko. "Naturwissenschaftliche Untersuchungen des Sarekgebirges in Schwedisch-Lappland", 2, Abt. 1, Meteorologie und Geophysik, Lief. 1, 1-76. (Stockholm, 1923.)

<sup>5</sup> According to Schmidt, W., *Sitz. Ber. Wien*, 118, 71 (1909).

<sup>6</sup> "Snow Crystals", by W. A. Bentley and W. J. Humphreys (McGraw-Hill Book Co., Inc., New York, 1931).

## Mendel, Morgan and Genetics

By Prof. E. W. MacBride, F.R.S.

THE modern science of genetics has acquired an enormous extension. As Prof. McDougall has said, it has swept over North America like a whirlwind. Everywhere chairs in genetics have been established, nay more, in some places special chairs in 'Drosophily' devoted to the exclusive study of this type-animal. Its votaries claim that in this science are to be found the solution not only of all the questions of the origin, propagation and improvement of our domesticated animals and cultivated plants, but also of the origin of species and evolution. Nevertheless, as time went on, the fair prospects of the science darkened. The hope of getting an unlimited number of new and valuable varieties was disappointed. As one of the professors of this science has ruefully expressed it, "The qualities that mendelize are not those which are of any value to farmers and those which farmers value do not mendelize." Anyone who reads, as I do, the minutes of the Agricultural Research Council, which contain an account of all the agricultural experiments seeking Government aid which are being carried out in Great Britain, must be struck with the fact that Mendelism is scarcely ever mentioned.

If 'genetics' be defined as the study of heredity free from presuppositions, then this study will be readily acknowledged to be a most important branch of the science of biology. But in practice, 'genetics' means the interpretation of hereditary phenomena according to fixed rules or postulates which were worked out by the late Dr. W. Bateson in Great Britain and by Prof. T. H. Morgan in the United States.

The discovery by Mendel of the facts of alternative inheritance and their rediscovery by Bateson and Correns were hailed as the greatest advance in biology since the publication of "The Origin of Species". The first question to be asked is whether what Bateson called 'unit-factors' and which are more frequently termed 'genes' have really the significance which has been attached to them. Mendel himself did not suppose that the phenomena of alternative inheritance covered more than a small part of heredity, but the persistent effort of all subsequent geneticists has been to crush all cases of heredity into this mould.

Bateson, who had the advantage of a broad education in biology at a time when in fame and brilliance the Cambridge School was at its zenith, really did most, especially in his later years, to clarify the position. He showed that alternative characters or 'allelomorphs', as he termed them, were related to each other in such a way that the dominant was characterized by something which was absent in the recessive. This definition was afterwards altered to stronger and weaker expressions of the same character. The classical experiments on peas will illustrate this point clearly. Yellow peas are dominant to green peas. But all peas when immature are green; the yellow pea on ripening transforms its chlorophyll into etiolin whereas the green pea stops short in its development. Similarly, round peas are dominant over wrinkled peas. Again, all young peas are round: in dominants, the round form is retained



owing to the transformation of an adequate amount of sugar into starch, but in the wrinkled peas less starch is found and an amount of sugary solution remains, and when this dries up in ripening, a shrinkage occurs which leads to a wrinkled seed-coat. When, therefore, two parents mate and each has some of the specific characters in their dominant form, this merely means that some of the specific characters are more strongly marked in the mother and some in the father. It is sometimes possible to mate two forms such as a regular sea-urchin and a heart-urchin which have been distinct for millions of years, and in the offspring the paternal influence may sometimes show and at other times the maternal. In picking out a recessive as a new variety to be propagated, we are really selecting a weakened form. As he grew older, Bateson became more and more convinced that an increasing number of cases of inheritance could not be brought under the Mendelian laws at all.

But the great extension which 'genetics' has attained in recent years is undoubtedly due to Morgan. He has, with a certain amount of justice, been termed the founder of the science of genetics. As is well known, in the ripening of the nuclei of the sexual cells a stage occurs which is known as 'meiosis'. In this stage, the paternal and maternal chromosomes approach each other in pairs and appear to come into actual contact with one another; they then separate, and half go to one pole of the nucleus and half to another. The nucleus then divides and the number of chromosomes is thus reduced to one half: the sexual cell is now ready to unite with another one with a similarly reduced number of chromosomes and so in the zygote the full number is restored. Now, according to Morgan, when meiosis takes place, the pairing chromosomes are very long and spirally twisted, and Morgan assumes that they break and exchange portions of their substance. If, then, the Mendelizing factors are based on discrete material particles situated in definite positions in the chromosome, the transference of dominant characters from one partner to another could be accounted for. Further, if two factors were situated near each other in the chromosome, it might be expected that the break would occur in such a manner that the separated piece would contain both factors. In this way, the association of two factors in inheritance was explained. The farther apart the position of the factors in the chromosome the more seldom would they be included in the same broken-off piece, and by the relative frequency of their association enthusiasts have attempted to construct a map of the chromosome and even to reckon the distance of two factors (in 'centimorgans') from each other.

It may appear to some readers that this whole theory is a rather risky castle of cards to erect on the basis of certain very dubious assumptions; and it is one of the main purposes of this article to show that these assumptions are incorrect, and consequently the whole chromosome theory falls to the ground. The question which we wish to put is whether the appearances of two long chromosomes slightly curved around one another are really an expression of meiosis or not. In my opinion, this question has been definitely decided in the negative by two researches, namely, "The Spermatogenesis of *Lepidosiren paradoxa*" (*Quart. J. Micro. Sci.*, 57, 1911) by Dr. W. E. Agar of Glasgow (now professor of zoology in the University of Melbourne) and "The Meiotic Phase in Vertebrates" by Prof. C. E. Walker of the Department of Cytology in the University of Liverpool. The latter research was published in two papers, namely,

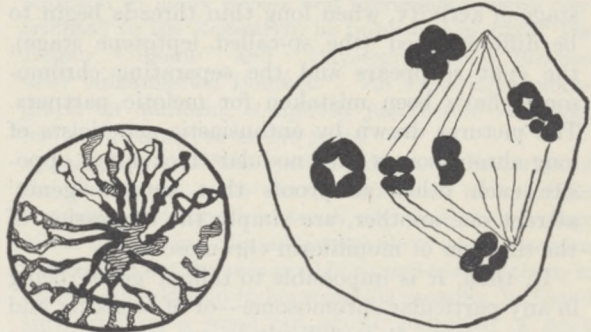


Fig. 1.  
THE 'FIRST' MEIOSIS  
OF *LEPIDOSIREN*

Fig. 2.  
THE 'SECOND' MEIOSIS  
OF *LEPIDOSIREN*

"The Meiotic Phase in *Triton vulgaris*" (*Proc. Roy. Soc.*, B, 98; 1925) and "The Meiotic Phase in Certain Mammals" (*Proc. Roy. Soc. B*, 99; 1926).

Agar's researches were suggested to him by his teacher, Prof. Graham Kerr. This was a stroke of genius on Prof. Kerr's part. He argued thus: if so much importance is attached to minute details in the ripening process of the nucleus, would it not be essential to study them in the largest nuclei available? He knew well that the nuclei of the sexual cells of the testes in *Lepidosiren* were gigantic, so large indeed that it is impossible to include one of them as a single microtome section.

Agar found the ripening process beginning with the apparent apposition of two long chromosomes in the manner described by Morgan, and as he was at the time an orthodox geneticist, he interpreted it in the same manner. But to his amazement, when the putative meiotic partners separated, they shortened and condensed and the same partners then underwent a *second meiosis* during the ripening of the same nucleus! The so-called first meiosis as described by Agar is shown in



Fig. 1; the second in Fig. 2. In the 'second' meiosis it can be seen that the chromosomes are reduced to short rounded nodules, and any supposition that they could break and exchange pieces of substance is obviously ludicrous.

But Agar's supposition that the same two partners could undergo meiotic pairing twice in the same ripening cycle is clearly incredible, and the account given by Dr. Walker unravels the mystery. By his researches, which were begun on the newt in his first paper and continued on several mammals in his second paper, he has proved conclusively that Agar's 'first meiosis' is not a meiosis at all but a belated ordinary division of the nucleus. This begins in the telophase of the preceding division of the sexual cell. When this division is complete and the daughter nuclei are passing into the resting phase, the telophase filaments can be seen to be split. In the resting phase this split disappears. But in the subsequent stage of activity, when long thin threads begin to be differentiated (the so-called leptotene stage), the split reappears and the separating chromosomes have been mistaken for meiotic partners. The pictures drawn by enthusiastic geneticists of long chromosomes with nodular thickenings opposite each other as proofs that similar 'genes' attract one another, are simply the expression of the division of moniliform chromosomes.

If, then, it is impossible to talk of 'genes' being in any particular chromosome—or of breaking and crossing over—it is difficult to see what remains of modern 'genetics'. As readers of NATURE are well aware, I am convinced that functional heredity, in other words, the handing on in some degree of habits acquired in one generation to the next, has been finally proved to be true, and this principle once admitted is sufficient to explain evolution and the origin of natural races and species. But the question of the origin, nature and inheritance of mutations, otherwise 'sports', remains to be dealt with. On this subject a great deal of light has been thrown by Prof. Mohr, of the University of Oslo, in a paper entitled "Über Letalfaktoren mit Berücksichtigung ihres Verhaltens bei Haustieren und beim Menschen" (*Zeitschrift für induktive Abstammungs- und Vererbungslehre*, 41; 1926). He shows that in *Drosophila* and in other forms an astounding number of mutations are what he terms 'lethal' or 'sub-lethal'. In *Drosophila*, the so-called 'modifying' factors which by themselves produce no outward visible effect and indeed whose existence is assumed in order to force the facts into the Morgan scheme, produce no effect on the viability of the insect. These he places in fanciful comparison at the red end of the spectrum. As we pass towards the yellow and green we encounter

mutations which make a marked difference in the appearance of the insect, and these decrease the viability until in the blue we encounter the sub-lethal mutations which injure their carriers so much that they can only be reared in a cross with a normal form. We finally reach the lethal factors in the violet, which even in a cross cause the death of their carriers. He shows further that such mutations are distributed over all the chromosomes and that new lethal factors are continually coming into being.

The obvious conclusion is that all mutations are of the physiological nature of damage to the growing powers of the germ, and when we consider the known artificial means of producing mutations, such as X-rays, heat, etc., applied to the eggs, this conclusion is so clear as scarcely to require statement. These agents kill the majority of eggs subjected to their influence: some resist them unaltered and some are half-killed and grow up to produce the mutations. Beneficent mutations which could survive in the struggle for existence are figments of the imagination.

Johannsen's demonstration that in a 'pure line' fluctuating variations are non-heritable marks one of the great advances in evolutionary knowledge, for it destroyed the basal assumption of the classical Darwinian theory that heritable variations in all directions are constantly occurring, some of which may *chance* to fit the environment and so be preserved. It was he who invented the term 'gene' as the cause of a mutation. About this word he says ("Some Remarks about Heredity," *Hereditas*, 4, 1923): "I introduced the word 'gene' when I was possessed by the antiquated spirit shown in Galton's, Weismann's and Mendel's viewpoints. Here we shall try to exterminate in genetics the term 'unit-character' because it indicates a notion inadequate and noxious for genetics. The most important part of the genotype does not seem able to segregate into units; as yet we are operating with characters which are superficial in comparison with the fundamental specific organic nature of the organism. However we try to analyse a genotype into factors we must remember that the characters of the organism, that is, its phenotypical features, are the reaction of the genotype *in toto*. Mendelian units *per se* are powerless. Are the experimentally demonstrated units anything more than expressions for local deviations from the original normal state of the chromosomes? *The Weismannian distinction between germ-plasm and soma, that is, absolute independence, does not exist in reality.* 'Gene' has nothing to do with De Vries's expression 'Pangenesis' and their behaviour as units; the phenotype is the reaction of the genotype (nature) with the ambient conditions (nurture)."



## Obituary Notice

### Prof. Hans Reck

PROF. HANS RECK, professor in the Institute of Geology and Palæontology of the Friedrich-Wilhelm University, Berlin, died suddenly of heart-failure at Lourenço Marquez on August 4, at the age of fifty-one years. He was on his way from Natal to Lake Eyassi, Tanganyika Territory, to examine the locality where Dr. Kohl-Larsen discovered a human skull in 1935 (NATURE, 138, 1082; 1936).

Hans Reck was born in Würzburg on January 24, 1886. He studied geology at the Universities of Berlin, of Munich, where he graduated as Ph.D. in 1910, and of London, at University College. During his undergraduate years he visited Iceland in company with his future wife, Fräulein Ina von Grumbkow, who survives him. In 1912 he was appointed leader of the Tendaguru Expedition of the University of Berlin; in 1913, leader of the Geological Expedition to Central Africa sponsored by the Royal Prussian Academy; at the end of 1913, leader of the Olduvai Expedition of the Universities of Berlin and Munich; and during the years 1915-19 he held the post of Government geologist in German East Africa.

After the Great War, Reck had not the same opportunities for work in the foreign field. Nevertheless, he twice visited Santorin, in 1925 and 1929. He was a member of the second Olduvai Expedition, in 1931, under the leadership of Dr. L. S. B. Leakey, and in 1932 visited South Africa to collect fossil reptiles. He left Germany at the end of September 1936 to carry out researches in the Cameroons, South Africa, Tanganyika and Kenya Colony; this trip was interrupted by his untimely death.

Reck's work on the geology of East Africa is

inadequately represented by a number of scattered papers. As editor and part author of the "Wissenschaftliche Ergebnisse der Oldoway-Expedition, 1913", he had the satisfaction of seeing the palæontological results published in full; but the difficulty of raising funds caused many delays, and his account of the geology, which was to appear at a later date, was left unfinished. Nor did he issue any technical description of the giant caldron volcanoes, every one of which he had climbed. Nevertheless, he was a great pioneer in this field, and his influence on post-War research cannot easily be estimated.

Most of Reck's published work relates to volcanoes, on which he was a leading authority. He appears as a *Mitarbeiter* in the first part of the *Zeitschrift für Vulkanologie* (1911), and as joint editor in 1923. In addition to many papers and numerous reviews contributed to the *Zeitschrift*, he published in 1923 "Die Hegan Vulkane" and "Physiographische Studien über vulkanischen Bomben". An exhaustive monograph on Santorin, completed just before he began his last journey, is in the press.

Tall, fair, and blue-eyed, Reck was a Bavarian of the finest type. His sunny disposition and upright character endeared him to all who had the privilege of his friendship. Himself incapable of an ungenerous thought or act, he was unable to understand them in others. In addition to his scientific pursuits, he found time to form a small but choice collection of Arab art, to become a gifted pianist, and to cultivate the delightful literary style which appears in "Oldoway, die Schlucht des Urmenschen", and in "Buschteufel", a volume of light-hearted stories of the campaign in East Africa and of life as a prisoner of war in Egypt.

A. TINDELL HOPWOOD.

## News and Views

### Mr. C. C. Paterson, O.B.E.

MR. CLIFFORD C. PATERSON, director of the Research Laboratories of the General Electric Co. Ltd., has had the honorary degree of doctor of science conferred on him by the University of Birmingham "in recognition of his many contributions and services to electrical science". Dr. Paterson, who is now fifty-seven years of age, was for sixteen years a member of the staff of the National Physical Laboratory, where he established and administered the Electrotechnics and Photometry Divisions of the Laboratory until 1918. He then accepted the task under Lord Hirst of initiating the G.E.C. Laboratories at Wembley. These have now grown so much in size and influence that they have a personnel of 500 and cover a floor area of about 170,000 sq. ft. Dr.

Paterson's activities have not been confined to the Wembley Laboratories. He was president of the Institution of Electrical Engineers in the year of the Faraday celebrations (1931). He has been president of the International Illumination Commission, the Illuminating Engineering Society, and this year of the Institute of Physics; he is also a vice-president of the Royal Institution and of the Royal Society of Arts. He has been Faraday lecturer of the Institution of Electrical Engineers, Huxley lecturer of the University of Birmingham, and is this year Guthrie lecturer of the Physical Society. Whilst Dr. Paterson's activities in engineering and science have covered a wide range, his chief personal contributions and scientific papers have been in the fields of light and lighting.



### Palæolithic Man in Brittany

IN view of recent reference to the fact that evidence of a Palæolithic Age had not been found in Brittany (see NATURE, Aug. 21, p. 329), it is of interest to note that M. R. Mazères records in the current number of *L'Anthropologie* (47, 3-4) that he has found a number of flint implements of that period, when examining the quaternary deposits of the cliffs in the bay of St. Brieuc (Côte-du-Nord). The deposits include a lower and upper loess. Of these the lower, a gray loess attributed to the Riss glaciation, is ravined by interglacial deposits of marine origin, with an abundance of *Buccinum reticulatum*, and evidence of a superimposed raised beach at an altitude 8-9 metres, which would warrant an attribution to Mousterian, or Tyrrhenian II. Above this, and at times associated with traces of the raised beach, is the upper loess, showing evidence of two periods of deposition. In the earlier deposits of this phase were found a dozen flint implements of Mousterian facies, with flakes of diabase and other stone of the same technique in working, and the tooth of a reindeer. The use of stone other than flint is attributed to the scarcity of the latter material in the neighbourhood. The later deposits yielded two well-made carinated scrapers of flint of Middle Aurignacian type. In the same horizon, but at another site, were found a reindeer tooth and the tooth of one of the Bovidæ. The attribution of the upper loess to Würm I and Würm II is thus confirmed by the character of the contained implements. M. Mazères points out that, modest as these finds are, they serve to indicate the existence of a palæolithic culture in Brittany. This is now apparently recorded for the first time; but M. Mazères recalls that in 1926 Prof. Milon and the Abbé Leclerc found a mammoth tusk in the loess to the north of Pléneuf, near the location of the present finds, and with it were flints which have not been studied.

### Recent Archæological Excavations in Great Britain

THE continued examination of the neolithic barrow at Chilham, Kent, known as Julaber's Grave, which is in course of excavation by Mr. R. F. Jessup on behalf of the owner, Sir Edmund Davis (see NATURE, August 7, p. 228), has brought to light further evidence regarded as confirming local tradition. The occurrence, among other finds, of equine bones and teeth (*The Times*, August 16) seems to afford some foundation for the belief that the remains of one hundred horses and one hundred men were buried in the barrow. An examination of the teeth, however, suggests that the horses may have been buried there at various times in a period of centuries. Excavation has ceased for this season, but will be resumed in July next. A five weeks' season of excavation at Milber Camp, Newton Abbot, conducted by the Devon Archæological Society under the direction of Mr. F. C. Cottrill, leads to the conclusion that the camp was constructed in the last century before the Roman invasion for the purpose, it would appear, of commanding the junction of two important tracks, and that it was abandoned when the Romans built

a bridge over the river at Teignmouth. Among the finds brought to light in the course of the excavation were a polished stone axe, a sling stone, decorated spindle whorls and pottery. The site was reoccupied in the Middle Ages, probably by shepherds.

Two food vessels, attributed to a date of about 2000 B.C., are reported to have been unearthed by workmen employed in the Fife Redstone Quarry, Belmullo, near St. Andrews. They were found at a depth of three feet below the surface on the side of a hill. They stand about six inches high, have a diameter of about four inches, and are ornamented with a decoration of cord impressions. Operations at the Meare Lake Village, near Glastonbury, in Somerset, were resumed for the current season on August 23. Dr. A. Bulleid and Mr. H. St. George Gray are again in charge of the excavations, acting on behalf of the Somerset Archæological and Natural History Society. The work of investigation this year will be confined to the central portion of the main group of dwellings of the East Village, upon which operations have been concentrated for the last four years. Until four years ago the West Village had been the principal site of excavation. A monograph has been prepared and is about to be published on the results obtained in the period between 1910, when the systematic examination of this site began after the close of investigations at the Lake Village of Glastonbury, and 1933, when excavation on the West Village was brought to an end. About half this part of the site had then been investigated. The excavations this year will be carried on for a period of four weeks.

### Excavations on the Roman Site at Wroxeter

THE Committee of the Wroxeter Excavation Fund has issued an appeal for funds to enable it to continue excavation on the Roman site of Uriconium. Previous investigations have covered about ten acres of a total area of 200 acres. Excavations were undertaken last year on a small scale by the Shropshire Archæological Society. It is proposed to continue these excavations. Generous assistance has been given by Sir Charles Marston, who is president of the Shropshire Archæological Society, and subscriptions have been promised by the Society of Antiquaries of London and All Souls' College, Oxford. The excavation again will be directed by Miss Kathleen Kenyon, who was in charge last year. The objects of this season's operations will be the further examination of the so-called Baths building by excavation on its north side, and the identification and excavation of the east gate of the city. It is anticipated that these investigations will throw light on three important problems: the history of the defences, the plan of the city, and the line of Watling Street, which is here in dispute. Donations should be addressed to the secretary of the Fund, Mr. A. E. Cooper, 28 Claremont Hill, Shrewsbury.

### Industrial Research in India

THE report of the Industrial Research Bureau, Government of India, for 1936-37, covers the work of the Industrial Research Council and the research



work at the Government Test House as well as the work of the Bureau (Delhi : Manager of Publications, 1937. 14 annas ; 1s. 6d.) The Industrial Research Council is an advisory body, consisting of representatives and non-official nominees of the central, provincial and leading State Governments, which meets once a year to discuss policy in the co-ordination and development of research. Programmes for road research have been approved by the Council, and the development of the manufacture of casein plastics has been considered both by the Council and by the Bureau. Industrial standardization and the compilation of a list of researches in progress or contemplated in industrial laboratories are also receiving attention, and a number of prizes have been awarded by the Council for papers bearing on industrial development. The research branch of the Government Test House which deals with the research programmes suggested by the Council and other problems referred to the Bureau has completed a preliminary investigation on the characteristics which affect the setting of red lead paint. For accelerated weathering tests on various paints the weatherometer, modified to give test conditions approximately to outside weather conditions at Alipore, has been used.

SPECIAL apparatus has also been developed in India for accelerated life tests on dry cells and considerable attention has been devoted to the use of vegetable oils for internal combustion engines. A process has been developed for rendering castor oil miscible with mineral oils of known suitability for use in such engines, and the effects of various antioxidants have been investigated. Steady progress has been made with the work of modifying the Morris and Lister engines and of equipping them with accessories to render the operating conditions fully controllable. Another section has been responsible for important investigations on the properties of petrol-benzole mixtures and the effect of changes in the composition of the benzole. A number of investigations on sand, lime, surkhi, clay, etc., have been initiated. Good progress has been made with the design of the equipment for the proposed road test track at Calcutta. Separate chapters in the report deal with work on glass and on oils and soaps, the former including the improvement of glass furnaces and a survey of glass-making materials.

#### Research in the Iron and Steel Industry

At the request of the Board of Trade, the Import Duties Advisory Committee has conducted an inquiry into "The Present Position and Future Development of the Iron and Steel Industry", and its report, which is full of interest, has now been issued (Cmd. 5507. London : H.M. Stationery Office, 1937. 2s. net). The report is essentially concerned with economic conditions, but its authors recognize that both the present and the future of the industry are closely bound up with scientific control and research. They express their satisfaction with the provision made for research and their hope that it will be further

extended in the future. The total industrial subscription to the Iron and Steel Industrial Research Council for 1936-37 is estimated as £30,000. As the capital of the concerns estimated to be responsible for 86 per cent of the country's output of steel in 1936 is given as £126.7 millions, this cannot be considered an excessive allowance. Several of the large steel concerns have their own research laboratories, involving a considerable expenditure, and these have actively collaborated in the investigations of the Council, thus making an indirect contribution. Full particulars of the research organization were furnished to the Committee by the Department of Scientific and Industrial Research in writing, but the seventy-three witnesses examined orally did not include a scientific metallurgist or a director of a research laboratory, and one would have welcomed a fuller appreciation in the report of the fact that the economies to be effected by scientific improvements—as, for example, in the field of refractories—are as important as the improvements in organization to which the report, thorough as it is, is almost entirely devoted.

#### Far Eastern Conference on Rural Hygiene

A CONFERENCE for Far Eastern countries on this subject was opened on August 3 by the Governor-General at Bandoeng, Java. This Conference was arranged by the League of Nations Health Organisation under the presidency of Dr. T. Offringa, director of the Netherlands Indies Public Health Service, with Dr. J. Rajchman, medical director of the League Health Committee, as secretary, assisted by Dr. C. L. Park, director of the Eastern Bureau of the Health Organisation. The Conference is meeting in five sections, in which the following subjects will be discussed: (1) health and medical services: the advantages and disadvantages of training 'semi-qualified' or assistant doctors to assist the qualified medical staff, and possible alternatives; (2) rural reconstruction and collaboration of the population, with the view of improving conditions of life in rural districts, a policy favoured by the Government of India and other countries; (3) sanitation and sanitary engineering, including housing, water supply, latrines, refuse disposal and fly control; (4) nutrition, a subject of importance in the East, for it has been estimated that 75 per cent of the population of Asiatic countries exist on a diet below the standards fixed by European science; (5) measures necessary to combat specific diseases, such as malaria, plague, tuberculosis, hookworm infection, yaws and leprosy, and mental diseases; also drug addiction.

#### The Science Museum

BESIDES the usual statistical information regarding the number of visitors and attendances at lectures, notes on special exhibitions, on acquisitions and the progress of the five main divisions of the Museum, the annual report of the Advisory Council of the Science Museum for 1936 is of especial interest as it contains a review of the growth and activities



of the Library, which is being developed as a National Library of Science. During the year, the Library was used by 22,000 readers, while the issues on loan of books and periodicals to Government departments, scientific and technical societies, colleges, etc., was 21,000. The Library receives more than 9,000 current periodicals and the contents of these are all indexed, references to these and to other matters now running into millions. There are about 250,000 books in the Library. "The two main functions of the Library," the report says, "may broadly be stated as the acquiring of documents and making them readily available", the latter consisting of cataloguing the volumes, maintaining indexes of their contents, provision of the volumes to readers, loan service, supply of bibliographies, supply of photostat copies, and Library publications. There have been many valuable additions to the collections in the Museum, and during the year under review special exhibitions were arranged illustrating the progress of research at very low temperatures, the scientific aspects of smoke pollution of the atmosphere and the developments in electric illumination.

#### Overhead Costs in Business Management

ONE of the most difficult tasks for a business management, whether the concern be large or small, is the adequate control of overhead costs. The usual classification of overhead expenses into salaries, rent, rates and taxes, legal expenses or the like is quite inadequate, because responsibilities cannot be tied up with the expenditure on these items, and generally there is no method of measuring the value obtained from the expenditure. In a valuable and thought-provoking report entitled "The Control of Overheads" (Mansfield House, 376 Strand, W.C.2. 5s.), prepared by a committee of the Management Research Groups, the subject is examined with the aim of securing effective control through localization of responsibility. To secure this, the report recommends the division of all overhead expenditure into a series of functions or services, each of which would be in charge of one person, thus permitting the fixation of responsibility. In order to assess the value of the work done by each section of the organization, its cost must be related to the volume of the work done and to the value or quality of that work; and for this purpose various ratios or 'yard sticks' are suggested in the report. The essential requirement is that responsibility for functional costs should be invested in persons, and to ensure that personnel shall cover each of the functions, it is most desirable that an organization chart should be constructed. Budgetary control is an excellent method of reviewing expenses in advance and making comparisons immediately results are available. Costs, however, may be rendered useless as a means of measuring efficiency because of plant working under capacity owing to insufficiency of orders. The report, therefore, recommends that the costs be 'purified' of the cost of idle plant by the abstracting and debiting of all such expenses to a non-productive account, which is carried straight on the trading account.

#### Economics of Wages and Price Levels

IN an address before the Economic Reform Club, London, on June 30, entitled "The Economic Reforms Required for Lasting Prosperity and Peace" which has now been issued in pamphlet form (Economic Reform Club, 61 Great Cumberland Place, London, W.1. 9d.), Mr. A. G. McGregor stresses the supreme importance of reform in wages regulation in securing a steady purchasing power of the pound. He urges that the method of adjusting wages by industrial dispute should be abolished and replaced by direct government control to adjust wages in accordance with the price level. This would in the first instance involve raising wages and salaries to a level which would bring consuming power in step with productive power, and thereafter the wages board would maintain the proper relation between wages and price level. He stresses the point that bankers should be relieved of all responsibility over the general price level and outlines the functions of a rational banking policy designed to accommodate industry and commerce with the necessary funds but under rules which eliminate any monetary influence on the price level. He contends that if wages and salaries are controlled in the way indicated so as to secure a satisfactory equilibrium between consuming power and productive power, economic liberty is no more affected than individual freedom in general by the ordinary government responsibility for maintaining law and order, and also that the higher wages and internal consuming power would assist the export trade.

#### Purchasing Power with a Managed Gold Standard

IN a pamphlet entitled "A Managed Gold Standard" (W. Heffer and Sons, Ltd., Cambridge), E. A. Meyer urges that unemployment and economic distress are due to lack of purchasing power. The State's lack of purchasing power has necessitated higher taxes, which have further decreased the citizen's purchasing power. This lack of purchasing power is due to lack of counters, or money, used for exchanging one man's labour for another's, caused by the inability of an inflexible money standard to keep pace with a continuous rise in prices. He advocates accordingly a managed gold standard based on the monopolization by the State of the note issuing bank of the standard (gold), and the fixation of the standard's money value by an international commission which should revise this value periodically according to the need of the world's productive ability to ensure the standard's flexibility. The managed standard will instantly increase the purchasing power of the State by increasing its right to issue counters without risk of devaluation, and this increased purchasing power by permitting decreased taxation will increase the purchasing power of the citizen as well as thus stimulating industrial and commercial prosperity. Unemployment will be further diminished or eliminated by the increased ability of the State to initiate public works. The managed gold standard could be introduced if a few countries only agreed to do so, since other countries would be bound to follow.



### The Television Cable

IN the Engineering Supplement to the *Siemens Magazine* of June, Mr. A. Rosen describes the London television cable which joins the Alexandra Palace studio to Broadcasting House and goes thence to the Whitehall Telephone Exchange. Success is being achieved and provincial cities are looking forward to having broadcast television services. It is probable that eventually there will be a network of television cables interconnecting the studios and transmitters throughout the country, similar to the grid of the programme circuits which now exists for sound broadcasting. Television is analogous to telephony. In telephony the voice sounds are converted by the microphone into equivalent alternating currents; these are transmitted to the receiving loud-speaker, where they are converted back to the voice sounds. Similarly the visual image is converted by the television camera into equivalent electric currents which are carried to the receiver where the cathode ray tube converts them back to the visual image. In both cases the transmission between sender and receiver can be effected over a metallic circuit, or by a radio link or by a combination of the two methods.

THE chief points of difference between the two transmissions concern the band of frequencies which have to be transmitted. In telephony, for music it suffices to transmit currents of frequency lying between 50 and 10,000 cycles to get excellent results. The television camera generates a much wider band of frequencies. In the Marconi-E.M.I. system, the frequencies range from zero to more than two million cycles. This necessitates the use of a correspondingly high carrier frequency for radio television transmission. The B.B.C. is to be congratulated on its notable achievement in televising the Coronation procession. This was the first successful high-definition relay in the world. The E.M.I. and Siemens gave valuable assistance to the B.B.C. in carrying out this enterprise. The author states that for trustworthy transmission between points more than 25 miles apart cables are necessary. Radio links also are liable to be affected by 'man-made' disturbances such as the radiations produced by the ignition systems of motor cars.

### The Electrification of the Rigi Railway

IT is now sixty-six years ago since the first rack railway in Europe, the Rigi railway, between Vitznau on the Lake of Lucerne and the top of the Rigi, was opened. It will be electrified in the autumn of the present year and will be brought into line with the latest modern requirements. The new motor-coaches will be light and comfortable, and the increase in speed will shorten the trip considerably. Fewer employees will be required as the preliminary work done in starting up the steam locomotives will be done away with and because it is easier to supervise electric vehicles. One-man control also suffices in the motor-coaches. When peak track conditions occur some of the existing steam locomotives can be used, and these are kept as a useful stand-by. The

electric equipment of the motor-coaches will be built by Brown, Boveri and Co., Ltd., Baden, while the mechanical part and coachwork will be constructed by the Swiss Locomotive Works at Winterthur. Direct current will be used at a pressure of 1,500 volts and the average running speed will be about nine miles per hour. On the up-grade, the highest running speed is about eleven miles an hour and on the down-grade about seven miles an hour. The difference in altitude between the Vitznau and Rigi Kulm stations is about 4,300 feet, and the steepest gradient is 25 per cent. In the *Brown Boveri Review* of March, diagrams of the new coaches are shown. The braking devices comprise electric resistance braking as service brake on the down-grade and two hand brakes independent of one another and actuated by spindle from either driver cab. When the brake is applied on the up-grade it prevents the coach running backwards should the current fail. There is also an overspeed brake which operates on a brake drum on the motor and only acts on down-grade running. In emergencies it is put into action by a safety device.

### The House-Rat in the United States

ALTHOUGH the black rat (*Rattus rattus*) still predominates in the southern States, particularly in Florida and the States bordering the Gulf of Mexico, throughout the States in the temperate zone it has been displaced by the brown rat (*Rattus norvegicus*), which appears to have been introduced about the beginning of the American Revolution, in 1775. Now the rat population is enormous—in Texas some years ago 153,720 rat tails were collected in six weeks; in Georgia, Alabama and Texas during the typhus fever control campaign in 1934, it was estimated that 7,500,000 rats were destroyed on 747,608 premises treated, or approximately two rats for every person living on the premises. The total economic damage done by these pests is enormous. In the course of one of its inquiries, the Biological Survey received 14,650 replies from farmers co-operating in rat campaigns, and the annual losses therein reported averaged 35 dollars a farm, while a computation of the grand total of loss throughout the United States each year is 189 million dollars. In addition, rats are seriously concerned in the conveyance of certain diseases among human beings and domestic stock, and in an effort to arouse co-operative measures of rat-control, the U.S. Department of Agriculture has published an eighteen-page circular (No. 423, Jan. 1937) on "The House Rat".

### Migrations of Salmon

AT a meeting of the Washington Academy of Sciences held recently, a discussion on the homing migrations of salmon was opened by Prof. Henry B. Ward. According to a report by Science Service, of Washington, D.C., he said that the return of salmon, generation after generation, to their ancestral breeding grounds, is a response to definite stimuli, amongst which he regards temperature as being the most powerful. Swiftiness of current has also some effect in guiding the fishes, although relative acidity of the water seems to have no influence. But if it be



admitted that salmon return to the streams where they were born—and there is much evidence supporting that view—it cannot be admitted that either the temperature of a particular stream or the swiftness of its current remains constant. It is difficult to understand, therefore, just how these variable factors can guide migrating salmon, not to a specially cold or swift stream, but to a particular stream the one outstanding character of which is that they were born there.

#### U.S. Zoological Expedition to Far East

A PARTY of scientific workers from Harvard and Johns Hopkins Universities has set out with the intention of making a survey of the birds and mammals of Siam, Borneo and Sumatra (Science Service, Washington, D.C.). The results should be of special significance, for the programme includes study of the social life of some of the most interesting of the higher monkeys. In the jungles of Siam, the habits of the gibbons will be observed for three or four months by Dr. Carpenter; other members of the expedition will carry out parallel observations in British North Borneo on orang-utans, gibbons and proboscis monkeys; while, later, in the mountains of northern Sumatra, orang-utans will be studied in the national park recently set aside by the Netherlands Government to protect this rapidly disappearing animal. It is expected that the study of the social habits of these creatures may throw light upon the problems of man's social and physical evolution.

#### Radio-Therapeutic Treatment of Cancer

THE Ministry of Health has issued an important publication on cancer treatment entitled "Cancer: Memorandum on Provision of Radio-Therapeutic Departments in General Hospitals", by Lieut.-Colonel Smallman (Reps. on Pub. Health and Med. Subjects, No. 79. London: H.M. Stationery Office. 9d. net). A principal reason for the preparation of this memorandum is the growing use of radium and X-rays in the treatment of cancer, in substitution for, or in conjunction with, surgery. As a result, hospitals in which cancer patients are treated need to be specially equipped and staffed for this part of their work. The memorandum emphasizes the importance of team work, and that the radio-therapeutic department should be in close touch not only with the surgical department, but also with other departments (gynaecological, pathological, etc.) provided by the hospital of which it should form an integral part. It concludes that a general hospital should contain some three hundred beds if it is to make reasonably full use of radiation treatment facilities. Plans are given for the lay-out of a radio-therapeutic department, the various features of which are explained in the text. The memorandum discusses how those hospitals which cannot provide full cancer treatment facilities can be enabled to make use of other hospitals in which full facilities exist. Appendixes contain the recommendations of the British X-Ray and Radium Protection Committee and of the Radium Commission on the care and custody of radium.

#### Physics at Harvard

THE volume of "Contributions" from the Physical Laboratories of Harvard University for 1935 is again of quarto form and consists of reprints without change of pagination, of fifty-seven memoirs by members of the staff, fellows and students which have appeared in scientific periodicals such as the *Physical Review*, the *Proceedings of the American Academy*, the *Review of Scientific Instruments*, during 1935 and the first two months of 1936. The quarto form allows the inclusion of the large double column pages of *Industrial and Engineering Chemistry*, but gives very wide margins to the single column pages of the *Proceedings of the Academy*. Work on the physical properties of materials at high hydrostatic pressure accounts for seven or eight of the memoirs, and special interest is attached to Prof. P. W. Bridgman's method of securing measurements at 50,000 atmospheres pressure in steel vessels which normally rupture at 20,000 atmospheres. Atomic physics accounts for about a dozen memoirs, of which that on the quantum theory of valence by Prof. Van Vleck and Dr. Sherman, a fellow of the National Research Council, reprinted from *Reviews of Modern Physics*, may be mentioned. The whole volume bears evidence to the active part Harvard is taking in the advance of knowledge.

#### Field Work of the Smithsonian Institution in 1936

THE preliminary survey of recent field work of the Smithsonian Institution ("Explorations and Field-Work of the Smithsonian Institution in 1936." Washington, D.C., 1937; pp. 100) covers nineteen investigations, beginning with Dr. G. C. Abbot's "Exploring Solar Power Possibilities" and including research in geology, palaeontology, zoology, botany and anthropology, the last-named predominating with seven investigations, mostly archæological. Of these last, Dr. Hrdlička's explorations of sites on Kodiak Island, Alaska, and the Aleutian Islands have attracted no little attention, not only on account of the exceptionally large number of antiquities brought back by this year's expedition, but also by the collection of mummified human remains from Kagamil. Dr. Henry B. Collins, jun., by his excavations at Bering Strait, has succeeded in determining beyond question the place of the Thule culture in the cultural succession at this gate of entry of man into the American continent—an important contribution to the Eskimo problem—and also has arrived at the conclusion that there is little hope of discovering any trace here of the passage of early man prior to the Eskimo, owing to physiographic changes. Further investigations by Dr. Frank H. Roberts, jun., on sites of the Folsom culture in Colorado and on a new site in Iowa discovered in 1935, the easternmost occurrence noted of the true Folsom stone point, have yielded new data bearing on the occurrence of this early type of the American stone age. It is now established that Folsom man was contemporary with the extinct camel, and also that he lived before, as well as at the same time as, the thick growth of vegetation which preceded the present condition of



aridity in the south-western area. This points to an antiquity even higher than that indicated by previous evidence.

#### Liverpool Naturalists' Field Club

THE seventy-sixth Annual Proceedings of the Liverpool Naturalists' Field Club, recently issued, covers the year 1936. The botanical notes include a summary by Mr. J. D. Massey of ninety new plant stations in the area recorded in the past four years since the compilation of Dr. Green's last "Flora of Liverpool", while Mr. W. S. Laverock, the botanical referee, describes the finding of deadly nightshade (*Atropa belladonna*) at Eastham, adder's tongue fern (*Ophioglossum vulgatum*) near the Manchester Ship Canal at Mount Manisty, young sycamore trees with variegated foliage at Irby woods, and other incidents of the field meetings of the year. The year's ornithological records, compiled by Mr. Eric Hardy, the ornithological referee, include a water-pipit, ruffs, a part-albino pied wagtail, curlew-sandpiper, little stint, greenshanks, green-sandpipers and a very late (November 28) yellow wagtail at Liverpool Sewage Farm, the latter (after a fog spell) a day later than the previous latest record in Britain; crossbills in the Ainsdale-Freshfield pinewoods in winter, a scaup wintering at the Botanic Park, Liverpool, puffins, fork-tailed petrels and mergansers in the Dee Estuary, a redwing summering in Knowsley Park and the nesting of the Canada goose and little grebe at Kirkby Dam, lesser black-backed gull and curlew at Simonswood, oyster-catcher and rock-pipit by the Ship Canal below Eastham, shoveller at Burton, grasshopper-warbler at Ince and Gayton in Wirral, and blackcap in Knowsley Park. The long-tailed duck is reported in full summer plumage feeding on crabs in West Kirby marine lake in mid-May. There are also the results of surveys carried out in the area for the British Trust for Ornithology, etc. The Committee reports an increase in membership during the year, the formation of a junior section, and an appeal for the Ornithological Fund.

#### Review of Agriculture

THE Royal Agricultural Society of England (16 Bedford Square, London, W.C.1) has published its ninety-seventh volume, which includes, as last year, the "Farmers' Guide to Agricultural Research". The latter consists of a review of research work in various branches of agriculture, each section being contributed by a recognized authority on the subject. The journal also contains a number of special articles on important questions such as housing the agricultural worker, labour, power and equipment in arable farming, the improvement of hill grazings and the technique of modern field experiments. On the animal side are articles dealing with the control of sheep ticks and systems of housing for pigs. The series on notable farm enterprises is continued, the Cambridge University Farm and Mr. Clyde Higgs's dairy farms being described in this number. The economics of farming are represented in an article on changes in beef imports before and after the Ottawa Agreement. The price of the journal is 15s.

#### British Scientific and Technical Books

A SELECT list of standard British scientific and technical books has been issued by the Association of Special Libraries and Information Bureaux. The list has been compiled at the request of the British Council and is planned as a guide in selecting books for a library. It is limited to about 300 works and is not a complete bibliography of the subjects covered, books out of print being omitted. Agriculture and medicine have been deliberately omitted, and the main purpose of the list is to assist in the choice of a collection of British scientific and technical books. Under each main section the books, so far as possible, are placed in a logical sequence of subjects, and it is intended that the ASLIB book list should provide a convenient means of keeping the select list up to date. The list contains a foreword by Sir William Bragg and an introduction by Sir Richard Gregory. The price of the list is 2s. to subscribers of the ASLIB book list and 2s. 6d. to non-subscribers.

#### Preliminary General Catalogue of Comets

VOL. 1, No. 4 of *Publications of the Kuwan Observatory* contains a catalogue of comets from the year 467 B.C. to the year A.D. 1936. The number of comets listed is 467, and in each case the best available orbit with its reference source is given. The present catalogue is the revision of a catalogue published in 1931 by Prof. Issei Yamamoto in the *Astronomical Yearbook of the Oriental Astronomical Association*, printed in Japanese. This revised edition of the catalogue by his son, Prof. A. S. Yamamoto, who contributes a preface in English, will be very useful to all students of cometary orbits. A more comprehensive general catalogue is in course of preparation by these authors.

#### Memorial to Sir Walter Morley Fletcher

AN account of the memorial to the late Sir Walter Morley Fletcher, secretary of the Medical Research Committee and Council in 1914-33, printed for the trustees of the memorial fund by the University Press, Oxford, has been issued to subscribers to the fund. It is illustrated with two plates, one of Miss Dora Clarke's posthumous portrait bust of Sir Walter Fletcher, photographed from the clay model, the other of a corner of the library of the National Institute for Medical Research with the finished bronze in position. After meeting the cost of this personal memorial, the balance of the fund is to be applied for a Walter Fletcher Memorial Laboratory at the Farm Laboratories of the National Institute at Mill Hill. The printed account contains appreciations of Sir Walter Fletcher by Prof. G. M. Trevelyan and Sir Gowland Hopkins.

#### Rehabilitation of Persons Injured by Accidents

THE Inter-Departmental Committee on the Rehabilitation of Persons injured by Accidents, set up jointly by the Home Office, Ministry of Health and Scottish Office, has issued an interim report (H.M. Stationery Office. 4d. net). This report deals particularly with the organization of "fracture clinics".



The object aimed at is the covering of the country with a network of services, for the most part attached to existing hospitals, and based upon a report issued by the British Medical Association in 1935. The need for such a service will be appreciated when it is stated that more than 201,000 new cases of fractures were treated at voluntary and municipal hospitals in Great Britain during 1935.

#### Science and the Life of the Community

At the meeting of the General Assembly of the International Council of Scientific Unions last May, a resolution from the Royal Amsterdam Academy of Sciences was adopted (with some modifications) for the appointment of a committee to examine various questions concerned with the practical application of scientific results in the life of the community. That committee has now been constituted as follows: Prof. J. N. Brønsted (Copenhagen), Prof. J. M. Burgers (Delft), Prof. S. Chapman (London), M. Establier (Paris), Prof. B. Nemeč (Prague), M. Francis Perrin (Paris) and Prof. F. J. M. Stratton (Cambridge).

#### Return of a Large Sunspot

THE leader sunspot of the extensive group, visible from July 22 until August 4, has returned to view, the following component having in the meantime disappeared. The area of this leader spot was about 1000 millionths of the sun's hemisphere on August 20, and on the following day, although the spot was not very far on the disk, it could be seen with the naked eye. The date of central meridian passage is August 25.3, and the sun's west limb will be reached on August 31. Since the spot is situated in fairly high latitude ( $33^\circ$  north), its drift backwards in longitude is very marked as compared with the angular rotation of the standard meridian (Carrington's) used in computing sunspot positions and which is given by the mean of sunspots in solar latitude  $15^\circ$ - $16^\circ$  north and south.

#### The Night Sky in September

ON September 23 at 11<sup>h</sup> U.T., the sun enters the sign Libra (the autumnal equinox). In the latitude of London, the night is then more than  $4\frac{1}{2}$  hours longer than at the time of the summer solstice. The moon is new on September 4 at 22.9<sup>h</sup> and full (the Harvest Moon) on September 20 at 11.5<sup>h</sup>. Conjunctions with the planets take place as follows: with Venus on Sept. 2 at 3<sup>h</sup>; with Mercury on Sept. 6 at 5<sup>h</sup>; with Mars on Sept. 12 at 18<sup>h</sup>; with Jupiter on Sept. 15 at 6<sup>h</sup> and with Saturn on Sept. 21 at 1<sup>h</sup>. An occultation of the star  $\xi$  Sagittarii (magnitude 3.6) occurs on September 14, the disappearance being visible from Greenwich at 18<sup>h</sup> 37.5<sup>m</sup>. On September 24, Venus approaches the bright star Regulus. A close appulse of Mars to the 9th magnitude star C.D. 11856 will be visible from South Africa on September 7 at about 17.6<sup>h</sup> U.T. During the month, Finsler's comet in the constellation Virgo continues to move southwards. The following ephemeris is given by Dr. A. D. Maxwell's orbit of the comet:

	R.A.	Dec.
Aug. 31	14 <sup>h</sup> 6.5 <sup>m</sup>	+ 6° 3'
Sept. 4	8.6	+ 1 48
8	10.2	- 1 37
12	11.3	- 4 24
16	12.3	- 6 45
20	13.2	- 8 45
24	14.0	-10 30
28	14.8	-12 3
Oct. 2	15.7	-13 27

There is a faint comet, discovered by Hubble on August 4, in the south-east region of Aquarius. Positions for Encke's comet (passing from Aries to Triangulum) and for comet Grigg-Skjellerup (passing from Ophiuchus to Serpens) will be found in the "B.A.A. Handbook".  $\beta$  Persei (Algol) is now becoming well placed in the late evening for observing the variability of its brightness. The change in light is best seen about 1.5 hours before and after the following times: Sept. 5<sup>d</sup> 03.5<sup>h</sup>, Sept. 8<sup>d</sup> 00.3<sup>h</sup>, Sept. 10<sup>d</sup> 21.1<sup>h</sup>, Sept. 28<sup>d</sup> 02.0<sup>h</sup> and Sept. 30<sup>d</sup> 22.8<sup>h</sup>. Meteors, the radiant of which is a little south-east of  $\epsilon$  Persei, may be looked for from September 7 until 15. The night sky during this month offers an unequalled range of various objects within reach of binoculars or small telescopes. In the middle of the month about 21<sup>h</sup>, the cluster of the Pleiades will be seen rising in the north-east. (All times are given in U.T.: add 1 hour to convert to Summer Time.)

#### Announcements

THE bicentenary of the birth of Luigi Galvani will be celebrated on October 18-20 by the town and University of Bologna and the Italian Society of Physics.

DR. MAX WESTENHÖFER, professor of general pathology and pathological anatomy in the University of Berlin, has been elected an honorary member of the Medical Association of Kinesiology at Buenos Aires.

DR. WERNER KUHN, extraordinary professor of physical chemistry at Karlsruhe, has been appointed full professor at Kiel in succession to Prof. Schwarz, who has been transferred to the chair of chemistry at Königsberg.

IN the famous Bialowieza National Park in Poland, a census of the game animals was carried out during the winter 1936-37, and the following count was made: stags 35, deer 78, wild boar 50, wolf 4 (temporary immigrants), lynx 7, fox 8, badger 10, otter 4, marten 5, polecat 19, hare about 30, woodgrouse 30 (*Kwartalny Biuletyn Informacyjny*, 29; 1937).

AN informal meeting to discuss how far scientific workers can help towards the planning of the land of Great Britain, which is one of the important topics of discussion this year at the meeting of the British Association, will be held at Nottingham by the Research Co-ordination Committee (LePlay House, 35 Gordon Square, W.C.1) at the suggestion of the Association of Scientific Workers.



## 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. 366.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Biological Effects of the Rays produced by a Cyclotron

BIOLOGICAL effects of neutron-rays from a cyclotron have been reported, on the change of blood pictures in living rats by Lawrence and Lawrence<sup>1</sup>, on the retardation of the germination of wheat seedlings by Zirkle and Aebersold<sup>2</sup>, and on the fatal dose of the sarcoma 180 by Lawrence, Aebersold and Lawrence<sup>3</sup>. They compared the effects of fast neutrons with those of hard X-rays, and found that neutrons are, in fact, biologically, much more effective than in the case of X-rays.

Apart from these questions of the action of neutrons, we have been engaged in making experiments on histological changes in the organs of a mouse, irradiated with rays produced by bombarding a beryllium target with 2.8 MeV. deuterons from the cyclotron in this Institute.

Healthy male mice weighing 13-17 gm. were chosen for use because of their small size, which made irradiation possible in the limited space available in the cyclotron. A glass cylinder, 2 mm. in wall thickness, 46 mm. in diameter, and 106 mm. in length, was divided into two parts by a glass plate inserted along the axis, one animal being put in each of the partitions. The cylinder was placed in the observation chamber of the cyclotron, and the two mice were irradiated simultaneously under the same conditions. The animals were kept at an equal mean distance of about 8 cm. from the beryllium target. The irradiation was continued for four hours with mean deuteron current of 0.4 microampere.

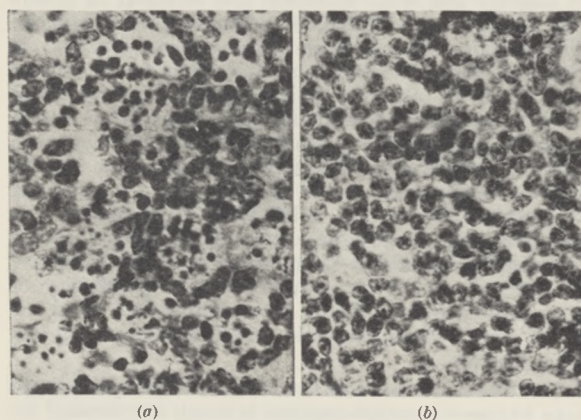


FIG. 1.

(a) IRRADIATED SPLEEN; (b) NON-IRRADIATED SPLEEN.

As was shown in the laboratory of one of us, histological change of the spleen in the rat, irradiated with X-rays, can be observed best about ten hours after the beginning of irradiation<sup>4</sup>.

Therefore ten hours after the beginning of irradiation the animal was dissected; the spleen and testes

were taken out, the former being fixed in Helly solution and stained with hæmatoxylin and eosin, while the latter was fixed in Champy solution and stained with Heidenhain's iron-hæmatoxylin as usual.

Fig. 1a shows a follicle of the spleen in the irradiated animal, and Fig. 1b the same part of the non-

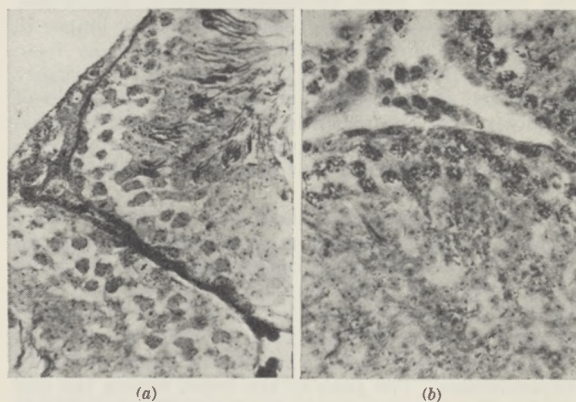


FIG. 2.

(a) IRRADIATED TESTICLE; (b) NON-IRRADIATED TESTICLE.

irradiated one; in the former, one can observe the remarkable decrease in the number of lymphocytes. Moreover, a large number of strongly stained dots in the same picture shows the destroyed particles.

In testicles, cells in the various stages of the spermatogenesis are more or less affected and destroyed, but interstitial cells, Sertoli's cells and spermatozoa are relatively intact. Further, one can observe in Fig. 2a that there is a diminution in radiosensitivity in passing through the various stages from spermatogonia to spermatozoa.

In conclusion, our thanks are due to Prof. S. Nishikawa and Dr. Y. Nishina for their interest in this work, to Mr. T. Yasaki and Mr. S. Watanabe for their assistance in the physical work, and to Dr. W. Nakahara for his hospitality in keeping our mice. We wish to thank the Japan Wireless Telegraph Company for the electromagnet and other equipments used for the cyclotron, and Mitsui Ho-onkwai Foundation and Tokyo Electric Light Company for financial support.

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Chemical Research, Y. YAMAMURA.  
Tokyo, July 13.

<sup>1</sup> Lawrence, J. H., and Lawrence, E. O., *Proc. Nat. Acad. Sci.*, **22**, 124 (1936).

<sup>2</sup> Zirkle, R. E., and Aebersold, P. C., *Proc. Nat. Acad. Sci.*, **22**, 134 (1936).

<sup>3</sup> Lawrence, J. H., Aebersold, P. C., and Lawrence, E. O., *Proc. Nat. Acad. Sci.*, **22**, 534 (1936).

<sup>4</sup> Motida, N., Sasao, T., and Koenuma, N., *Nippon Röntgen Gakkwai Zassi (Japanische Z. Röntgenologie)*, **14**, 201 (1936); Motida, N., Koenuma, N., and Sasao, T., *Nippon Röntgen Gakkwai Zassi*, **14**, 471 (1937).



### The Magnetic Field acting upon Neutrons inside Magnetized Iron

F. BLOCH<sup>1</sup> has recently discussed the nature of the magnetic forces between electron and neutron and suggested a quantitative investigation of the magnetic scattering of slow neutrons. We have tried an alternative way of getting some information on these forces by studying the precession of slow neutrons inside magnetized iron, in order to decide whether the magnetic field  $H$  or the magnetic induction  $B = (1 + 4\pi\kappa) \cdot H$  ( $\kappa$  being the susceptibility) determines the angle of precession<sup>2</sup>.

In two previous letters<sup>3</sup>, evidence has been given of the precession of polarized slow neutrons passing through a magnetic field which is perpendicular to the direction of polarization. In consequence of the inhomogeneity of the thermal neutrons (C-neutrons) this precession leads to depolarization, the slower neutrons precessing more because they stay longer in the field. Polarized C-neutrons originating from paraffin cooled down to 90° K. should be practically depolarized after passing through 7 mm. of a field of 35 gauss. On the other hand, a field of 2.8 gauss along the same path will give an average precession angle of about 15° only and very little depolarization of the neutrons.

In our experiment, C-neutrons at 90° K. were allowed to pass through an iron polarizer and an antiparallel iron analyser, both magnetized to 14,000 gauss. The stray field outside those two iron bars was less than one gauss. A long coil was interposed between polarizer and analyser, its axis, the fields in the iron bars and the neutron beam being mutually perpendicular. The path of the beam within the coil was 7 mm. Currents producing 2.8 or 35 gauss inside the coil were switched on alternately. Taking more than 600,000 counts with a boron chamber (50 per cent of which were due to C-neutrons) we obtained  $(0.83 \pm 0.26)$  per cent more counts with 35 gauss in the coil than with 2.8 gauss. This is the order of magnitude to be expected for the polarization effect according to our previous experiments.

An iron sheet of 0.15 mm. thickness was then placed inside the coil and the magnetic circuit was closed by connecting the ends of the sheet by means of an iron yoke. Another 600,000 counts were taken using the same currents as before. The difference between the number of counts with the high and the low field was only  $(-0.05 \pm 0.24)$  per cent this time. It is seen that the polarization effect had disappeared.

We conclude from this experiment that the lower field is sufficient to depolarize the neutron beam entirely when the iron sheet is interposed. Since the path of the neutrons within the iron sheet (where depolarization must have occurred) was only 0.15 mm., the precession of the neutrons inside the iron has to be accounted for by an 'effective field' of  $\sim 500$  gauss or more. The field strength  $H$  in the iron was 2.8 gauss only, the induction  $B$  was  $\sim 15,000$  gauss; hence  $B$ , or at least  $0.03 B$ , must have acted upon the neutrons inside the iron.

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August 5.

<sup>1</sup> Bloch, F., *Phys. Rev.*, 51, 994 (1937).

<sup>2</sup> The equivalent problem of the deflection of electrons inside magnetized iron has been discussed by C. F. v. Weizsäcker, *Ann. d. Phys.*, 17, 869 (1933).

<sup>3</sup> NATURE, 139, 756 and 1021 (1937).

### The Initial Stages of Glycolysis in Muscle Extracts

WE have already made a preliminary report<sup>1</sup> on the preparation from rabbit muscle, by a method involving repeated extraction with phosphate solution, of solutions of the glycolytic enzyme system, which appear to be more free from associated co-enzymes than are extracts prepared by other methods. The extracts convert starch to lactic acid in the presence of muscle *Kochsafft*, but do not do so in the presence of adenosine triphosphate, magnesium ions, cozymase and a trace of hexose diphosphate; an account of their properties, with the evidence of a participation of a new co-enzyme, will shortly be given in detail elsewhere.

In view of the current interest in the earliest stages of the transformation of polysaccharide in muscle extracts<sup>2</sup>, we should like to direct attention to the behaviour of the extracts referred to above, in the presence of the co-enzymes, namely, adenosine triphosphate and magnesium ions, which have been regarded by most workers as effecting the initial phosphorylation in the chain of reactions. The points of interest are as follows:

(1) When magnesium ions alone have been added as co-enzyme, no esterification of phosphoric acid has ever been observed.

(2) When in addition to magnesium ions adenosine triphosphate is also present, rapid esterification takes place, and the ester formed consists at first wholly of an easily hydrolysable ester with the properties of the hexose-1-monophosphoric acid recently described by Cori and Cori<sup>3</sup>. In the later stages of the incubation the total amount of esterification increases more slowly and the easily hydrolysable ester is gradually converted into hexose-6-monophosphate. No other ester appears to be formed under these conditions.

(3) The rate of formation of the easily hydrolysable ester is roughly the same over a range of adenosine triphosphate concentrations from M/1,000 to M/10,000, is slightly less with M/50,000 and reduced to about one quarter with M/200,000 adenosine triphosphate. The amount of adenosine triphosphate required is therefore much less than that necessary for glycolysis as a whole to take place with optimal speed, and the amount of ester formed is far in excess of that which could be formed by simple transference of phosphate from the added adenosine triphosphate to the starch. If the mechanism were of this kind, continuous rephosphorylation of adenosine diphosphate or adenylic acid would have to take place, and no means of bringing this about seems to be present. No lactic or pyruvic acid is formed, so that the possibility of rephosphorylation from phosphopyruvic acid is ruled out. Adenylic acid itself brings about no esterification.

(4) The conversion of the hexose-1-monophosphate into hexose-6-monophosphate is much accelerated by the addition of a trace of hexose diphosphate.

The results described above are not in agreement with those reported from Parnas's laboratory<sup>4</sup>, where esterification in the absence of any added co-enzyme was observed, or with those of Lehmann and Needham<sup>5</sup>, who were able to confirm the findings of the above-mentioned school. The possibility that starch behaves differently from glycogen in this respect is being investigated. But since an easily measurable esterification is produced even by



M/200,000 adenosine triphosphate, one hesitates, in view of the well-known difficulty of eliminating co-enzyme completely from the enzyme system, to accept the evidence for esterification without co-enzymic intervention which has so far been provided.

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<sup>1</sup> Kendal and Stickland, *J. Soc. Chem. Ind.*, **55**, 1030 (1936).

<sup>2</sup> Needham, *Ann. Rev. Biochem.*, **6**, 401 (1937).

<sup>3</sup> Cori and Cori, *Proc. Soc. Exp. Biol. and Med.*, **34**, 702 (1936).

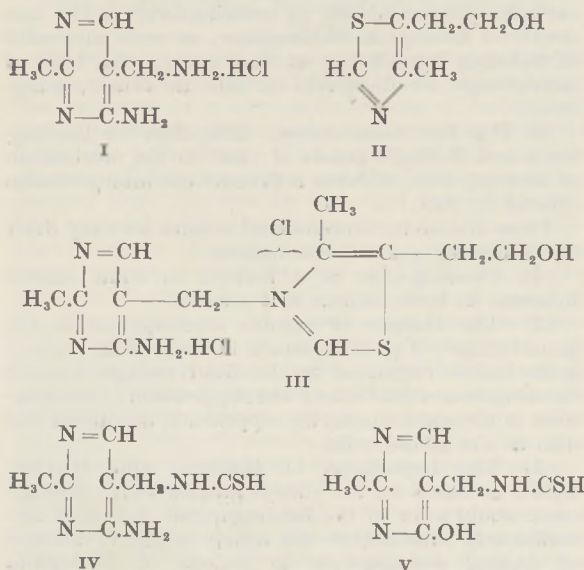
<sup>4</sup> Ostern, Guthke and Terszakowec, *Z. physiol. Chem.*, **243**, 9 (1936).

<sup>5</sup> Lehmann and Needham, *Biochem. J.*, **31**, 329 (1937).

### Growth Factors for *Phycomyces*

DURING the last three years, Schopfer has published several papers<sup>1</sup> showing that vitamin B<sub>1</sub> is a growth factor for *Phycomyces*. This mould can now be grown on a synthetic medium composed of glucose, asparagine, inorganic salts and the vitamin. During the last two years, he has described<sup>2</sup> an alternative growth factor ('MP') which differs from the vitamin in being resistant to heat (128° C. for 20 hours causes only 75 per cent loss of activity) and resistant to alkali; it is oxidized by hydrogen peroxide.

Knight<sup>3,4</sup> has shown that his growth factor for *Staphylococcus* consists of three parts, two being the pyrimidine (I) and thiazole (II) components of vitamin B<sub>1</sub> (III), and the third being nicotinic acid or its amide. Very recently Schopfer and Jung<sup>5</sup> have stated that vitamin B<sub>1</sub> can be replaced as a growth factor for *Phycomyces* by the pyrimidine and thiazole components.



Through the kindness of Dr. Todd, I had also been able to test four synthetic compounds (I, II, IV and V) as growth factors for *Phycomyces*. On a medium composed of glucose, asparagine and inorganic salts, no growth is obtained when these four compounds are added singly. But I and II together give a very large growth (cf. Schopfer and Jung), IV and II a

fair growth, while V and II give no growth. Further, a neutral solution of vitamin B<sub>1</sub>, autoclaved for two hours at 125° C., still acts as growth factor for *Phycomyces*, although the compound is destroyed. The activity of compounds I and IV is not destroyed by this treatment, even in presence of N/10 NaOH; hydrogen peroxide, however, destroys the activity. This supports Schopfer's suggestion that his factor 'MP' consists of degradation products of vitamin B<sub>1</sub>. There is no doubt that vitamin B<sub>1</sub> itself, as well as its constituents, is a growth factor, since a solution sterilized by filtration through glass instead of by autoclaving remains active. Vitamin B<sub>1</sub> diphosphate ('co-carboxylase' of Lohmann), which was kindly supplied by Prof. Lohmann, is about as active as the vitamin itself.

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<sup>1</sup> Schopfer, *C.R. Acad. Sci.*, **200**, 1965 (1935).

<sup>2</sup> Schopfer, *Z. Vitaminforsch.*, **4**, 187 (1937).

<sup>3</sup> Knight, *NATURE*, **139**, 628 (1937).

<sup>4</sup> Knight, *Chem. and Ind.*, **56**, 445 (1937).

<sup>5</sup> Schopfer and Jung, *C.R. Acad. Sci.*, **204**, 1500 (1937).

### Constituents of Vitamin E Concentrates from Rice- and Wheat-Germ Oils

THE pioneer work of Evans and his collaborators on the anti-sterility factor (vitamin E) has culminated in the isolation from the unsaponifiable fraction of wheat-germ<sup>1</sup> and cotton-seed<sup>2</sup> oils of three apparently isomeric oily alcohols  $\alpha$ -,  $\beta$ - and  $\gamma$ -tocopherol of approximate formula C<sub>28</sub>H<sub>50</sub>O<sub>2</sub>, all of which show high vitamin E activity. The use of the unsaponifiable fraction of rice-germ oil as a source of vitamin E was advocated by Kimm<sup>3</sup>, who later<sup>4</sup> prepared from a purified concentrate a  $\beta$ -naphthoate, m.p. 156°, which yielded on hydrolysis a product alleged to have very high vitamin E activity.

By acylation of purified concentrates from the unsaponifiable portion of rice-germ oil with *p*-nitrobenzoyl chloride or  $\beta$ -naphthoyl chloride we obtained a complex mixture of oily and crystalline esters. The crystalline esters on separation and hydrolysis yielded three apparently homogeneous crystalline isomeric alcohols of formula C<sub>30</sub>H<sub>50</sub>O, (a) m.p. 121°-122°, (b) m.p. 113°-114° and (c) m.p. 119°-120°. The alcohol (c) yields a  $\beta$ -naphthoate corresponding in its properties to that of Kimm's active material; but like (a) and (b) it is devoid of vitamin E activity. Of these alcohols, (a) may be polyterpenoid in nature but (b) and (c) are certainly akin to the sterols, being similar in their properties to the tritosterols obtained by Karrer and Salomon<sup>5</sup> from wheat-germ oil concentrates. In a parallel investigation of wheat-germ oil we isolated in similar fashion  $\beta$ -amyryn and two isomeric alcohols C<sub>30</sub>H<sub>50</sub>O of the tritosterol type, (d) m.p. 113°-114° and (e) m.p. 175°; of these (d) was also obtained by Karrer and Salomon. Neither (d) nor (e) possessed vitamin E activity.

The purified oils remaining after removal of these crystalline alcohols from both rice and wheat concentrates had a high biological activity, and gave, on thermal decomposition, considerable quantities of durohydroquinone C<sub>10</sub>H<sub>14</sub>O<sub>2</sub>, which Fernholz<sup>6</sup> obtained by similar treatment of pure  $\alpha$ -tocopherol. On treating the oil from the wheat concentrate with cyanic acid in benzene, a mixture of allophanates



was obtained from which the products described by Evans, Emerson and Emerson<sup>1</sup> could be isolated, in addition to a crystalline allophanate, m.p. 70°, which has not yet been examined biologically.

The above purified oil from the rice concentrate deposited on standing a crystalline substance, m.p. 73°, which appears to be an aliphatic mono-unsaturated alcohol containing approximately 20 carbon atoms. After removal of this alcohol, the oil on saturation with cyanic acid in benzene solution gave a complex mixture of substances from which a small amount of an allophanate, m.p. 135°–138°, having the properties of  $\beta$ -tocopheryl allophanate<sup>2</sup>, could be isolated together with a larger quantity of an allophanate, m.p. 195°–200°; the parent alcohol of the latter substance is being tested biologically.

In view of the formula of the tocopherols and the probability that they may represent mono-alkyl ethers of durohydroquinone<sup>3</sup>, the occurrence in active rice-germ oil concentrates of the alcohol m.p. 73° may be of some significance. The work on the structure of these various compounds, of which fuller details will be published elsewhere, is being continued.

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<sup>1</sup> Evans, Emerson and Emerson, *J. Biol. Chem.*, **113**, 319 (1936).

<sup>2</sup> Emerson, Emerson and Evans, *Science*, **83**, 421 (1936).

<sup>3</sup> Kimm, *J. Agric. Chem. Soc. Jap.*, **11**, 514 (1935).

<sup>4</sup> Kimm, *Sci. Pap. Inst. Phys. Chem. Res. Tokyo*, **28**, 74 (1935).

<sup>5</sup> Karrer and Salomon, *Helv. chim. Acta.*, **20**, 424 (1937).

<sup>6</sup> Fernholz, *J. Amer. Chem. Soc.*, **59**, 1154 (1937).

#### Para-Cresol from the Urine of Pregnant Mares

Burrows, Cook *et al.*<sup>1</sup> have recently isolated *p*-cresol, along with certain ketones of the sterol group, from the urine of a man with a malignant tumour of the adrenal cortex. The urine (30 l.) was submitted to an initial hydrolysis by boiling with hydrochloric acid, and 0.75 gm. of *p*-cresol was isolated from the non-ketonic phenol fraction.

It should be recorded that in this Laboratory a similar observation has been made in regard to the urine of pregnant mares. Approximately 110 gm. of pure *p*-cresol, containing no detectable trace of *o*- or *m*-isomeride, was obtained from 400 gallons of mares' urine, which had been submitted to hydrolysis—a considerably higher proportion than that reported by Burrows, Cook *et al.* for a pathological specimen of human male urine. The significance of this finding is not yet apparent.

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Burrows, Cook, Roe and Warren, *Biochem. J.*, **31**, 950 (1937).

#### Artificial Release of Crossing-over in Meiosis and Mitosis

THE experiments with artificial production of crossing-over described below belong to a new series which were finished in the spring of this year; they enable us to carry our analysis much further and bring out a series of facts which are entirely new. The following are the main conclusions drawn from this work:

1. (a) X-ray treatment of *Drosophila melanogaster* males induces not only spermatogonial, but also meiotic crossing-over.

(b) Histological examination of irradiated testes revealed that the early spermatocytes of the first order possess the greatest susceptibility to treatment, whereas the spermatogonia, though also affected, react to a much less extent.

2. (a) The mitotic origin of spermatogonial crossing-over induced by X-rays in *Drosophila melanogaster* has been definitely established.

(b) The presence of inversions lowers somewhat the frequency of spermatogonial crossing-over throughout the non-inverted region of chromosome III. This proves that there is a similarity between regular meiotic and induced mitotic crossing-over.

(c) The frequency of spermatogonial crossing-over is extremely high in the central region (which carries the spindle fibre) of chromosome III. In the remaining regions of the chromosomes there is a closer correspondence with the cytological map than in the case of the normal meiotic crossing-over in females.

(d) The frequency of induced crossing-over is higher for later than for earlier spermatogonial stages.

(e) The frequency of spermatogonial crossing-over is not proportional to the X-ray dose (a comparison at 1,000 r. and 4,000 r. shows a frequency greater than fourfold in the latter case).

3. (a) No oogonial crossing-over was released in female larvae of *Drosophila melanogaster* with a treatment of 2,000 r.

(b) The  $\frac{Cy}{b\ cn\ c}$  females used in this experiment

showed nevertheless a statistically significant increase in crossing-over between 'b' and 'cn'. Since only the gonial stages were irradiated, this result must be taken to mean that there exists an after-effect of the treatment on crossing-over.

4. (a) Contrary to the current point of view, which excludes the possibility of crossing-over in the late oocyte of *Drosophila melanogaster*, we were successful in inducing interchange at that stage; this type of interchange we designate as late meiotic crossing-over.

(b) This fact raises certain difficulties for Darlington's and Belling's points of view on the mechanism of crossing-over, whereas it favours the interpretation offered by Sax.

From the above summarized results we may draw the following general conclusions:

(1) Crossing-over is a feature to some extent inherent in both meiosis and mitosis.

(2) The absence of regular crossing-over in the gonial stages of gametogenesis in *Drosophila melanogaster* can be explained by the disadvantages somatic crossing-over would offer; the suppression of crossing-over in the soma means its suppression in mitosis and also in the gonial cells.

(3) The hypothesis of Haldane and Huxley, which is based on the disadvantages that crossing-over would offer in the heterogametic sex, does not sufficiently substantiate the nearly complete absence of normal crossing-over in meiosis of *Drosophila melanogaster* males.

A detailed account of the work will appear in Russian (with an extensive German summary) in the *Biologichesky Zhurnal*.

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July 13.



## Cobalt, and Sheep Diseases

IN New Zealand, Askew and his co-workers have shown that cobalt plays a vital part in the healthy life of sheep and that small supplements of cobalt salts will cure sheep suffering from a type of anæmia. Sheep on Dartmoor are liable to a disease very similar in symptoms to those described by the New Zealand workers, and the usual practice of farmers is to send their flocks to lowland pastures in the autumn for two or three months.

Analyses of the cobalt content of the soils from moorland pastures on which sheep suffer and from lowland pastures on which sheep have been known to recover give striking differences which are statistically significant:

Moorland soils on which sheep suffer have a mean cobalt contents of 3.9 parts per million; lowland soils on which sheep recover, 16.7 parts per million.

The figure for the sickness soils is higher than that given by Kidson<sup>1</sup> for corresponding soils in New Zealand, where it was found that sickness was associated with soils having a cobalt content of two parts per million. In the Dartmoor district this figure would be about four parts per million, although occasionally samples have a slightly higher content.

Analyses of pastures show that those in the sickness areas have a mean content of 0.20 part per million cobalt and those in the recovery areas 0.45 part per million.

An examination of soil and pasture composition is in progress, and the relationship of these to the incidence of disease is being studied.

The Laboratory,  
Dartington Hall,  
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August 13.

J. B. E. PATTERSON.

<sup>1</sup> Kidson, *N.Z.J. Sci. and Tech.*, 18, 694 (1937).

## Effect of Occluded Hydrogen on the Rigidity of Metals

AN investigation of the above effect was prompted by an inquiry into the nature of the earth's interior. The existence of a very definite core of radius half that of the earth seems established beyond reasonable doubt by seismology. The nature of this core is puzzling. Tidal phenomena and the Eulerian nutation demand that this core be less rigid than the crust. The noticeable absence of the shear wave on earthquake records of quakes sufficiently distant for the waves to pass through the core (and this, despite the presence of very pronounced compressional waves of the same quake on the record), was taken to mean that the core could not transmit a shear wave. A liquid core was therefore quite generally held to fit in with all known phenomena. However, during the past few years several seismic investigators, after exhaustive study of records, feel reasonably sure that the shear wave does pass through the core, but with greatly diminished energy. This would seem to imply either that a fluid under high pressure can transmit a shear wave, or that the core of the earth is a solid of very low rigidity. The idea suggested itself that a solid solution might satisfy this picture of a solid of low rigidity.

To test this, a solid solution of hydrogen in palladium was experimented with. The first question proposed was, "Does the occluded hydrogen affect the rigidity of the palladium?" The purpose of this communication is to state that apparently it does. The rigidity was measured by means of a torsion

pendulum. A small magnetized needle was suspended by a palladium wire half a millimeter in diameter. The needle was placed in an oscillating magnetic field of variable frequency. The period of the pendulum was obtained by measuring the frequency of the oscillator at resonance, which was found to be quite sharp. In the formula  $\mu = 8\pi l/r^2 T^2$ ,  $l$ ,  $r$  and  $T$  were determined before and after occlusion, which was produced by electrolysis. The results were quite erratic, some of the causes of which will be gone into later. However, there was a noticeable change produced in the rigidity of the metal, namely a decrease of rigidity with increasing occlusion. Some twenty different wires were tried and the change in rigidity measured when the wire was saturated with hydrogen. At first fairly long lengths of wire were used, but eventually it was found convenient to use short suspensions about 2.5 cm. long.

The average decrease in rigidity on saturation was found to be 13.7 per cent. The experiments were carried out *in vacuo*, in hydrogen and in air, but beyond a slight change in amplitude of the pendulum, no measurable change in period was noticed in the three cases. The best absolute value of the coefficient of rigidity of palladium into which no excess hydrogen has been forced was found to be  $4.257 \pm 0.030 \times 10^{11}$ . All palladium normally contains a certain amount of hydrogen apparently, and if this be driven off by passing a current through the wire, the above figure for the rigidity will be at least 12 per cent higher.

Starting with a piece of uncharged wire, a current of 10 amp. was passed through for a few seconds, heating the wire to redness. The rigidity increased 1.7 per cent. The current was again passed through for about a minute and the rigidity increased a further 8.4 per cent. The wire was then charged with about 400 times its volume of hydrogen. The rigidity decreased 16.6 per cent. Current was again passed through to drive out the hydrogen, this time for several minutes. The rigidity increased 22.8 per cent. The wire was again charged with about 450 times its volume of hydrogen and the rigidity decreased 21.0 per cent. It seems fairly certain, therefore, that the occluded hydrogen causes a decrease in the rigidity of the metal. The investigation is being continued further at Fordham and New York Universities jointly.

*Note added in proof:* The work of K. R. Koch in this field has not been overlooked, but will be discussed later.

JOSEPH LYNCH, S.J.

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June 28.

## Kinetics of Catalysed Polymerization of Styrene

INVESTIGATIONS of polymerization kinetics have often required rather cumbersome experimental methods, but Hammick and Langrish<sup>1</sup> have recently applied a convenient bromination method for estimating cyclopentadiene and indene to a study of the polymerization rates of these compounds in carbon tetrachloride. We have been using, for some time, a very similar method to follow the kinetics of the polymerization of styrene, catalysed by anhydrous stannic chloride, in carbon tetrachloride and chloroform solutions at 25°C. The amount of residual monomeric styrene in the reaction mixture is determined, at known intervals of time, by quantitative bromine addition to the double bond, using an excess of bromine which is estimated by titration in the usual way. The accuracy of the analysis (better



than 0.5 per cent) is not impaired by the presence of polystyrene; but with polystyrene in the presence of stannic chloride, the excess bromine must be destroyed without delay, in order to avoid a slow attack of bromine on the polymer. The styrene disappearing during polymerization has been proved to be equivalent to the polymer formed by weighing the amount of polystyrene precipitated in methyl alcohol<sup>2</sup>. The polymers produced have molecular weights of the order 5,000 as determined by viscosity measurements.

With specially purified materials, the half-conversion period for polymerization may be of the order of one hour; but complex inhibition phenomena can appear if traces of impurity are present. In one series of experiments, with styrene concentrations up to 1.73 *M.* litre in carbon tetrachloride, and with commercial 'c.p.' stannic chloride at concentrations 0.01–0.2 *M.*, polymerization was preceded by a period of total inhibition (varying from 0.6 to 4.2 hours with decreasing concentration of catalyst), after which polymerization would proceed to completion with a half-conversion period of one to eight hours. Experiments during the polymerization period have shown (a) that moisture produces a retardation inflection in the polymerization curve, (b) that dry hydrogen chloride is a temporary complete inhibitor, the polymerization resuming its course after an interval which may amount to an hour or more. In separate experiments, we have found that hydrogen chloride adds to the double bond of styrene at a measurable rate with a stannic chloride catalyst, and that addition proceeds considerably more rapidly in chloroform than in carbon tetrachloride. This behaviour corresponds with the observation that, in pure chloroform, polymerization was preceded by an inhibition period of 0.15 hr. with reactant concentrations which gave inhibition for 1.3 hr. in carbon tetrachloride. (In unpurified, commercial, 'practical' chloroform there was no initial inhibition.)

It seems probable that inhibition of polymerization by hydrogen chloride, introduced by intent or present as an impurity in commercial stannic chloride, is due to saturation by hydrogen chloride of the double bonds of those styrene molecules which have been activated by the catalyst, polymerization being prevented until the inhibitor has been removed by the addition reaction. If this explanation is correct, it follows, as the simplest interpretation (since hydrogen chloride is a complete polymerization inhibitor within the analytical error), that styrene and stannic chloride probably form a complex, capable of surviving several molecular collisions, which is responsible both for hydrogen chloride addition to styrene and for the chain-initiation step in the polymerization of styrene. Skraup and Freundlich<sup>3</sup> have provided evidence for the formation of complexes between stannic chloride and certain aromatic hydrocarbons having unsaturated side-chains; and this view of the polymerization catalysis is in accord with recent observations by Gee and Rideal<sup>4</sup>.

Detailed experiments are in progress.

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July 19.

<sup>1</sup> Hammick, D. Ll., and Langrish, D., *J. Chem. Soc.*, 797 (1937).  
<sup>2</sup> Schulz, G. V., and Husemann, E., *Z. phys. Chem.*, B, 34, 187 (1936).

<sup>3</sup> Skraup, S., and Freundlich, L., *Annalen*, 431, 243 (1923).

<sup>4</sup> Gee, G., and Rideal, E. K., *J. Chem. Soc.*, 772 (1937).

### Polarimetric Studies of Oxide Film Formation on Metals

THE polarimetric method<sup>1</sup> has now been applied to the study of the early growth of oxide films on copper and has given results in general agreement with those obtained by other workers using different methods<sup>2</sup>. Typical curves showing the changes in  $\Delta$  (the relative phase retardation of the perpendicular and parallel components of the incident plane vibration) during heating and cooling of copper mirrors in dry pure hydrogen and after replacement of the hydrogen by pure dry air, are given in Fig. 1.

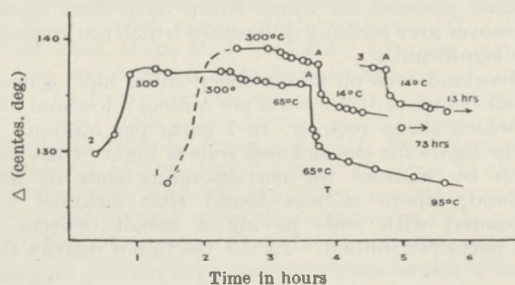


Fig. 1.

A, ADMISSION OF AIR; T, TEMPERATURE ROSE DUE TO INADEQUATE CONTROL

Calculations of the film thicknesses corresponding to the optical changes have also been made by means of approximate equations developed in the manner of Drude<sup>3</sup>, except that in the case of copper it was not found permissible to neglect some of the terms normally dropped. The thickness curves, together with those of Evans and Miley<sup>4</sup> (dotted) are given in Fig. 2.

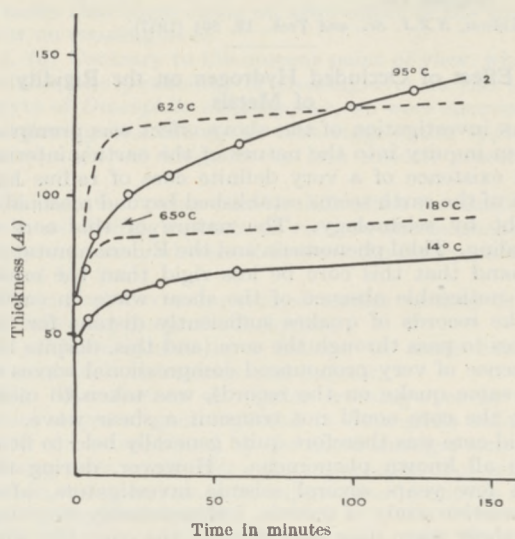


Fig. 2.

These latter would not be expected to be strictly comparable as they refer to oxidation of distorted surfaces beginning during polishing<sup>5</sup>, whilst the present results are for the re-oxidation of reduced annealed surfaces. It is also reasonable to expect differing degrees of activation or sintering and partial poisoning by sorbed hydrogen to have direct influence on the course of oxidation and to give rise to second order effects by modification of the optical constants of the base.



However, from this and other work mentioned, it is clear that the magnitude of the first rapid oxidation, even allowing for a considerably greater real surface, is much larger than would be expected from a sorption-diffusion oxidation theory<sup>6</sup>; and it seems that a controlling mechanism must be sought leading to differential equations of a similar form but involving other physical magnitudes. Detailed results and a discussion of them will be published in due course.

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July 8.

<sup>1</sup> Tronstad, L., *Trans. Faraday Soc.*, **29**, 502 (1933). Winterbottom, A. B., *J. Sci. Instr.*, **14**, 203 (1937).

<sup>2</sup> Evans, U. R., and Miley, H. A., *NATURE*, **139**, 283 (1937). Dobinsky, S., *NATURE*, **138**, 81 (1936).

<sup>3</sup> Drude, P., *Wied. Ann.*, **36**, 884 (1889); Tronstad, *loc. cit.* (1).

<sup>4</sup> Evans, U. R., and Miley, H. A., *loc. cit.*, (2).

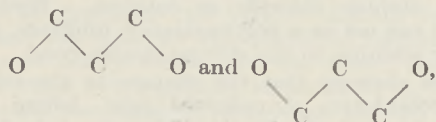
<sup>5</sup> Bowden, F. P., and Ridler, K. E. W., *Proc. Roy. Soc. A*, **154**, 640 (1936).

<sup>6</sup> Wilkins, F. J., *Phil. Mag.*, **11**, 422 (1931).

### Hydrogen Bridges in Solid Pentaerythritol

Using the method of Fourier series, a quantitative crystal analysis of pentaerythritol,  $C(CH_2OH)_4$ , has now been carried out, and some of the interesting features of the determined structure will be given below.

Of the alternative space groups  $C_2^2-14$  and  $S_6^2-14$  chosen first by one of us<sup>1</sup>, the latter should now be regarded as the correct one for this compound. The central carbon atom of a molecule is placed at 000 and surrounded tetrahedrally by the four methylenic carbon atoms at  $xyz$ ,  $xyz$ ,  $y\bar{x}z$  and  $\bar{y}xz$  with  $x = 0.165$ ,  $y = 0.140$  and  $z = 0.10$ , the interatomic distance for the C—C bond being hence 1.57 Å. The four hydroxyl oxygen atoms are also arranged in such general positions with the values of the parameters  $x = 0.313$ ,  $y = 0.265$  and  $z = 0.00$ . From these and above values the C—O bond distance is computed to be 1.46 Å. The oxygen atoms thus lie in the same plane  $z = 0$  as the central carbon and besides not far from the base diagonals. If the hydrogen atoms of the OH groups are not taken into consideration, the molecule possesses approximately the symmetry of  $D_{2d}-\bar{4}2m$ , precisely  $S_6-\bar{4}$ , with one pair of primary alcohol radicals puckered upwards and the other downwards, namely,



all the bond angles of these atoms being approximately tetrahedral. Such a structure is found in the case of pentaerythritol tetrabromide vapour, in which, according to an electron diffraction study carried out by de Laszlo<sup>2</sup>, the bromine atoms in the molecule form a square.

The most interesting aspect of the structure is the close approach of the hydroxyl groups on adjoining molecules. In the plane  $z = 0$ , four oxygen atoms, one out of each molecule, constitute a square of length of side 2.55 Å. This is shown by an idealized figure (Fig. 1), though strictly in the actual case the

line joining the central carbon and a hydroxyl oxygen in the molecule makes a small angle with one of the base diagonals.

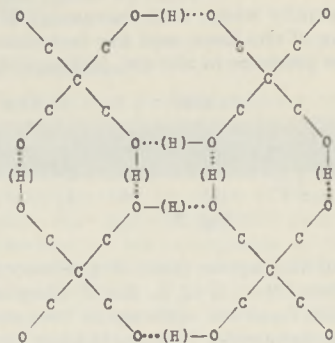


Fig. 1.

The value 2.55 Å. for the above O—O distance, which must be bridged by a hydrogen atom, is considerably less than that assigned by Bernal and Megaw<sup>3</sup> to their 'hydroxyl bond', while it is precisely the same as those found in the cases of  $KH_2PO_4$ <sup>4</sup> and  $NaHCO_3$ <sup>5</sup>, in which, however, the O—O distance is not between two OH groups but between OH and O. At any rate it is evident that the molecules in a layer parallel to the (001) plane are linked more or less firmly to each other by hydrogen bridges in closed rings, where, according to Huggins<sup>6</sup>, the 'synchronized oscillations' may cause an increased stability of the intermolecular linkage. Such layer-like structure explains in a natural way the perfect cleavage along (001).

A detailed account of the present work will be published shortly.

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July 6.

<sup>1</sup> Nitta, I., *Bull. Chem. Soc. Japan*, **1**, 62 (1926). For a further bibliography of this subject, see P. P. Ewald and C. Hermann, "Strukturbericht".

<sup>2</sup> de Laszlo, H., *C.R.*, **198**, 2235 (1934).

<sup>3</sup> Bernal, J. D., and Megaw, H. D., *Proc. Roy. Soc. A*, **151**, 384 (1935).

<sup>4</sup> West, J., *Z. Krist.*, **74**, 306 (1930).

<sup>5</sup> Zachariasen, W. H., *J. Chem. Phys.*, **1**, 634 (1933).

<sup>6</sup> Huggins, M. L., *NATURE*, **139**, 550 (1937).

### Band Spectrum of Thallium Hydride

THALLIUM metal was heated in vacuum resistance furnace, which was filled with hydrogen at 500 mm. pressure. At a temperature of about 1,500° C., some bands in the yellow and red part of the spectrum were emitted. The same bands were also obtained in the emission from a thallium-copper arc burning in hydrogen at high pressure. At low pressure (less than 500 mm. mercury) in the arc no bands were present. With increasing pressure the bands get gradually stronger, and at a pressure of about four atmospheres the yellow and red bands are intense. Under the same conditions in the arc a fainter band system also appears in the blue and violet part of the spectrum.

The spectrum has now been photographed from 8000 Å. to 4000 Å. One of the strongest bands at



$\lambda$  5680 is shown in Fig. 1. The band is degraded to the red and consists of two branches, which are designated as *R*- and *P*-branches. Only the first two or three lines in each branch are sharp, and the lines then get gradually wider with increasing *K*-numbers. This widening of the lines, and the fact that no bands appear at low pressure in the arc, indicate that almost

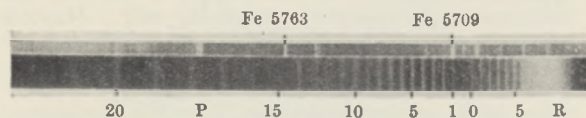


Fig. 1.

every level of the upper state is predissociated. At low *K*-numbers,  $0 < K \leq 9$ , the *P*-lines are single. For  $K > 9$  the lines are split up in two components with unequal intensity. As no *Q*-lines are present, the band probably is due to a  $\Sigma - \Sigma$ -transition. In the thallium hydride molecule, both  $^1\Sigma - ^1\Sigma$  and  $^3\Sigma - ^3\Sigma$  are possible, but since the lines are diffuse (only the first eight or nine *R*-lines are resolved) it is

at present difficult to distinguish between these two alternatives.

A similar but much fainter band lies at  $\lambda$  6150 Å. The two bands have a common upper state, and consequently they are designated as  $0 - 0$  ( $\nu_0 = 17,519.9 \text{ cm.}^{-1}$ ) and  $0 - 1$  ( $\nu_0 = 16,174.5 \text{ cm.}^{-1}$ ). The following constants have been calculated: upper state:  $B_0 = 4.64$ ;  $D_0 = -1.18 \times 10^{-3} \text{ cm.}^{-1}$ ; lower state:  $B_0 = 4.73$ ,  $B_1 = 4.62$ ,  $D_0 = -0.45 \times 10^{-3} \text{ cm.}^{-1}$ .

In the yellow and red part of the spectrum there are also some other bands with a somewhat more complicated structure, which show a characteristic widening of the lines similar to that of the two bands mentioned above. These bands can be followed into the far infra-red part of the spectrum.

Further details concerning the band spectrum of thallium hydride will be published later.

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July 9.

### Points from Foregoing Letters

PHOTOMICROGRAPHS showing the effect of irradiation with neutrons upon the spleen and testicles of mice are submitted by Prof. M. Nakaidzumi, K. Murati and Y. Yamamura. A decrease in the number of lymph cells can be observed in the spleen, while in the testicles, cells in the various stages of spermatogenesis are more or less affected and destroyed.

By studying the precession of neutrons within magnetized iron, Drs. O. R. Frisch, H. von Halban, jun., and Jørgen Koch have found that the 'effective magnetic field' which accounts for the rate of precession is a considerable fraction of the magnetic induction *B*, at any rate much larger than the magnetic field strength *H*.

Drs. L. P. Kendal and L. H. Stickland describe experiments carried out with purified extracts of the glycolytic enzyme system; these may throw light on the earliest stages of the transformation of sugar-like substances, from which the muscle derives its energy. Unlike previous investigators, they find that co-enzymes (both magnesium ions and adenosine triphosphate) are needed for esterification.

Further experiments with substances related to vitamin  $B_1$ , which stimulate the growth of the mould *Phycomyces*, show, according to H. M. Sinclair, that pyrimidine plus thiazole give a large growth, and thiazole plus the amide of nicotinic acid give a fair growth (in a medium of glucose, asparagine and inorganic salts), but they are not active separately.

A number of substances separated from the unsaponifiable fraction of rice-germ oil (which has high anti-sterility, vitamin E, activity), together with some of their derivatives, are mentioned by Dr. A. R. Todd, Dr. T. Bergel, H. Waldmann and T. S. Work. Most of these compounds are biologically inactive. An aliphatic mono-unsaturated alcohol containing approximately 20 carbon atoms is considered by the authors of some significance, as a possible simpler derivative of the tocopherols (alcohols of approximate formula  $C_{20}H_{30}O_2$ ) which have been shown to possess vitamin E activity.

Results of X-ray experiments with the fruit fly, *Drosophila*, leading to crossing-over of chromosomes

(producing mutation) are described by Prof. H. Friesen. Crossing-over in males was observed in the spermatogonial process both during normal nuclear division and also during the reduction division (meiosis). The frequency of spermatogonial crossing-over is not proportional to the X-ray dose.

Analysis of soils from Dartmoor, where sheep are liable to a type of anæmia (found to be due in New Zealand to a deficiency in cobalt), shows, according to J. B. E. Patterson, that the soil contains only 3.9 parts of cobalt per million on an average, whilst the soil in the lowland pastures, where the sheep are sent to recover, contains on an average 16.7 parts per million of cobalt.

It is stated by Father J. Lynch that when hydrogen is occluded in a metal, it apparently decreases the rigidity of the metal. In the case of palladium the decrease amounts to as much as 23 per cent.

Dr. G. Williams has used a bromination method for estimating styrene to follow the kinetics of its polymerization in carbon tetrachloride and chloroform at 25°C., with anhydrous stannic chloride as catalyst. Polymerization is rapid when specially purified materials are employed, but may be preceded by a period of temporary total inhibition with commercial stannic chloride as catalyst. Hydrogen chloride can act as a polymerization inhibitor, probably by addition to the styrene double bond.

Curves showing that the changes in the relative phase retardation of polarized light, falling upon copper mirrors, during heating and cooling in hydrogen and in air, are given by A. B. Winterbottom, also the film thickness of oxide corresponding thereto. The magnitude of the first rapid oxidation is much larger than expected from a sorption-diffusion oxidation theory.

A quantitative crystal analysis of pentaerythritol by I. Nitta and T. Watanabé has revealed an interesting layer-like structure. Molecules in a layer are linked more or less firmly to each other by the so-called hydrogen bridges, for which the O—O distance is found to be 2.55 Å. The molecular shape is similar to that of pentaerythritol tetrabromide in the vapour phase.



## Research Items

### Ancient Man in Devon

FOR some years past Mr. Reid Moir, in collaboration with Mr. and Mrs. MacAlpine Woods, has carried out archaeological investigations in the neighbourhood of Seaton and Beer in south-east Devon. These investigations have been confined to various deposits, ranging from Lower to, possibly, Upper Palæolithic times, situated at some height above sea-level, but until recently no opportunity had appeared for examining the low-lying beds of the river valleys. Fortunately, however, a sewage plant is being erected on the Flood Plain at the junction of the River Coly with the Axe, and from the spoil heaps from the excavations a large number of flint artefacts have been found. The exposed sections are shallow and of small extent, but the succession of deposits, from below upwards, is clearly as follows: (1) Flood Plain gravel; (2) alluvium, with stones, 2 ft.; (3) alluvium, practically stoneless, 1 ft. 6 in. The surface of the Flood Plain gravel at the site examined is approximately 15 ft. O.D. Judging from what has been discovered in other parts of Great Britain, the stony alluvium resting upon the Flood Plain gravel would contain an assemblage of artefacts dating from Magdalenian—late Palæolithic—times to the end of the Stone Age, and it is of interest to note that among the specimens recently found by Mr. Reid Moir and Mr. and Mrs. MacAlpine Woods are a number of blades of flint, including some definite and well-made burins. It is possible that these may be of Magdalenian date, and afford further evidence of the former presence of Palæolithic man in Devon. Other specimens in the series appear to be referable to later epochs, though nothing which can with confidence be assigned to the Neolithic period has yet come to light. The examination of the Colyford site is being continued, and it is hoped that it and the artefacts discovered may be described in the near future.

### Potassium and Paralysis

FAMILIAL periodic paralysis, as its name implies, is a hereditary disability characterized by periodic attacks of paralysis usually of the limbs. Aitken, Allott, Castleden and Walker (*Clin. Sci.*, 3, 59; 1937) have recently published observations which promise to illuminate this hitherto obscure malady. A patient was observed who attributed his paralytic attacks to heavy meals. It was found that the attacks could with regularity be produced about five hours after the ingestion of 250 gm. glucose, or by the injection of twenty units of insulin, or most surely by the combined effects of glucose and insulin. Analysis of the blood during and between the paralytic attacks showed that the onset of paralysis was associated with a fall of serum potassium from the normal value of 16–20 mgm. to below 12 mgm. per 100 c.c. serum. The paralysis could be relieved in 15 min. by the ingestion of 12 gm. potassium chloride. A fall in serum potassium occurs in normal individuals when glucose passes from the blood into the tissues, but in periodic paralysis the fall is unusually great, and it is this abnormality which constitutes the essential feature of the disease.

### Structure of Protoplasm

DR. A. R. MOORE is probably giving expression to a view very widely spread among biologists when he argues (*Scientia*, 62, July 1, 1937) that the conception of protoplasm as an emulsion, suggested by Bütschli and supported by some of Hardy's experimental results, was quite inadequate even to account for the behaviour of the cytoplasm of the cell. A useful purpose is probably served, nevertheless, in passing in review some of the considerations which suggest a more 'structural' basis. Thus in some merogonic hybrid embryos of echinoderms the tempo of cleavage of the cells of the hybrid is clearly determined by the parentage of the cytoplasm—not of the nucleus. In sea-urchin eggs, as the result of centrifugal action, it may be possible to obtain cells, clear of all dense inclusions, which behave quite normally on fertilization, but this clear hyaloplasm, although without visible structure, almost certainly has a structural framework conserving its role in the transmission of hereditary characters. The phenomena of flow in protoplasm is shown to be consistent with the presence of fibrillar elements; in this way alone would it seem possible to explain the behaviour of plasmodia of Mycetozoa, which will flow through hard paper filters with average pore size of  $1\mu$  though they are destroyed when forced through sieve pores less than 0.20 mm. in diameter. Dr. Moore's conclusion, that protoplasm contains polar particles or chains of molecules which, when occasion requires, link themselves into structural features, not only agrees with modern views of the mechanism of wall deposition at the surface of the plant protoplast, but also reconciles very generally the contrast between the mobility of the cytoplasm and the necessity for a structural framework to account for its performance in cell division and heredity.

### Researches on Indian Fishes

IN *Current Science*, 5, No. 7, 1937, there are two interesting articles on fishes. The first is entitled "Geographical Distribution of Indian Freshwater Fishes and its Bearing on the Probable Land Connections between India and the Adjacent Countries" by Sunder Lal Hora, assistant superintendent, Zoological Survey of India, Calcutta. It is a summary of the remarks made at the Hyderabad meeting of the Indian Science Congress, during a joint discussion between the Sections of Geology, Botany and Zoology, on Wegener's theory of continental drift with special reference to India and the adjacent countries. The evidence provided by the distribution of the freshwater fishes of India indicates an eastern origin of the fauna and its subsequent dispersal to the west. The close relationship between the Indian and the African freshwater fishes can only be explained on the assumption of a land connexion between the two countries. The absence of the Schilbeidae from Ceylon and their presence in Africa suggests that Ceylon may have become separated from India at a stage earlier than the severance of the land connexion between Africa and India. In the second paper, P. Sen, entomologist, Bengal Public Health Department, "On the Food Factors of the so-called Mosquito-



Destroying Fishes of Bengal—*Panchax panchax*, *Barbus stigma*, *Esomus danricus* and *Trichogaster fasciatus*", shows that the plankton flora and fauna form the main food of *Panchax* although they also eat insect larvæ, that *Trichogaster* eats plankton with filamentous algæ, and that *Barbus* and *Esomus* are also essentially vegetable feeders. Thus *Panchax* alone of the four eats insect larvæ, and these only form a small portion of the food. There is apparently no justification in assuming that these fishes would eat the *Anopheles* larvæ except in very small numbers.

#### Inheritance of Leukæmia in Mice

LEUKÆMIA is a tumorous condition in which the leucocytes of the blood multiply rapidly. The symptoms are very similar or identical in mouse and man. There is often enlargement of the spleen and lymphatics as well as an enormous increase of the number of leucocytes in the blood. Dr. E. C. MacDowell (*J. Hered.*, 28, No. 4) has described experiments on the inheritance of leukæmia in mice which are of particular interest in their bearing on the relation between intrinsic and extrinsic factors. By brother-sister matings through eighteen generations, a genetically uniform leukæmic strain of mice was obtained. In a total of more than 600 mice, however, 10 per cent always failed to develop leukæmia. But the offspring of the negative mice developed the disease with the same frequency of 90 per cent. It is concluded that the 10 per cent negatives represent the balance between the genetic constitution of this particular strain and the particular environment in which they developed. When a negative strain is crossed with a male from the leukæmic strain, the  $F_1$  show an incidence of nearly 45 per cent, and when  $F_1$  males are back-crossed to the neutral strain the incidence of leukæmia is again halved. When the leukæmic heredity is derived from the mothers, the incidence of leukæmia in the offspring is significantly higher in all cases. By careful analysis and variation of the laboratory environment, it will probably be possible to determine which extrinsic factors are effective. It is also significant that the role of extrinsic factors varies with the intrinsic factors present.

#### Research on Wood-destroying Insects

THE *Journal of the Royal Society of Arts* (85, 407; 1937) contains a report of a lecture given by Dr. R. C. Fisher of the Forests Products Research Laboratory on the above subject. Special reference is made to the death watch beetle (*Xestobium rufovillosum*), and it is pointed out that there appears to be a definite relation between the presence of fungal decay in timber and the occurrence of this insect. It was also shown that the temperature and moisture content of timber are important factors in determining the rate of development of the beetle. Warm, dry conditions and the absence of fungal decay are unfavourable for this insect. Damage is usually most severe at, and often confined to, the built-in ends of timbers in buildings where ventilation is poor and where conditions are favourable for the accumulation of moisture and consequent risk of decay. The outstanding conclusion of recent biological studies is the importance of the presence of fungal decay. Experiments are in progress to determine exactly how fungal decay renders timber suitable for infestation. Also the fact that *Xestobium*

can continue to live and develop very slowly in decay-free timber has to be taken into consideration. Reference is made to frequent reports in the press, and by authorities seeking funds for repairs, of damage caused by the beetle to churches and other buildings. The result has been a general impression that the creature has increased its activity during the last few years. This idea, however, is erroneous, and the apparent spread of the beetle can be best explained by the increased interest taken in its occurrence, which leads to more thorough inspection of old timbers in buildings.

#### Cytology of the Genus *Poa*

J. M. ARMSTRONG has examined the chromosome numbers of twenty species of the grass *Poa*, with the result that previous suggestions are confirmed and extended: (1) that polyploidy is associated with species formation; diploid to dodecaploid species are described, the basic chromosome number being seven; (2) that aneuploid species are also present; three aneuploid species have chromosome numbers suggestive of a  $9n$  origin (*Canadian J. Res.*, 15, June 1937). An interesting examination is made of the possibilities of the maintenance of a certain aneuploid strain with 54 chromosomes. In view of the obvious difficulties in the way of maintaining constant such an aneuploid strain through normal sexual fertilization, an apogamous origin of embryos from sporophytic tissue in the ovule seemed likely and has frequently been suggested. Armstrong, however, shows that the fertility of the pollen mother cells is surprisingly high and that polyembryony frequently occurs, but that the embryo sacs may all arise from megaspores produced after the normal reduction division. The author points out that the univalent chromosomes appear regularly to be included in the nuclei after reduction division. Four univalents are concerned, and in view of the high chromosome number their presence may not disturb the genetic balance if they undergo random segregation. Such random segregation would give 6 out of 16 pollen grains with 2 univalent chromosomes and, in view of the frequent occurrence of polyembryony, with good opportunities of meeting female nuclei with 2 univalent chromosomes also. Such gametes would contain 27 chromosomes in all and their union might maintain the strain by ordinary sexual reproduction; the author concludes that this is the method in which the aneuploid 'Mammoth' strain of *Poa pratensis* is reproduced.

#### Fulgurites from Witsands, Kalahari

AMONG the sand-dunes on the south-east border of the Kalahari desert, A. D. Lewis (*S. Afr. Geog. J.*, 19, 50; 1936) estimates that there are not fewer than 2,000 fulgurites ('lightning tubes') over an area of eight square miles. Curiously, however, the natives say that storms are not frequent and they have never seen the dunes struck by lightning. The friable tubes of fused silica are mostly found as broken fragments lying in the hollows between the dunes, and only rarely are they seen *in situ* projecting a few inches above the surface of the sand. Five tubes extending vertically downwards were excavated, but without reaching the lower end. The longest recovered (as fragments) measured 8 feet and showed some branching with a variable form and diameter (0.2–0.5 in.) along its course. Larger tubes (up to 2 in.)



have collapsed with the formation of longitudinal ribs. In one case threads of fused silica extend across the cavity, suggesting that the tube again expanded while still in a plastic condition. The sand surrounding the longest tube was seen to be "darkened as if burnt". Some previous records mention that the loose sand adjacent to the fulgurite is iron stained, suggesting that iron was vaporized from the fused silica. The author accepts, though apparently somewhat reluctantly, the view that these tubes were formed by lightning. One of his alternative suggestions is that they were formed by meteorites; this being supported by the statement that lechatelierite (silica-glass) has been found in meteorites—a statement that is quite incorrect.

#### The Baffin's Bay Earthquake of 1933

LATE on November 20, 1933, a strong earthquake was recorded at stations all over the world. The early estimates made at Kew, Strasbourg and elsewhere showed that the epicentre lay in Baffin's Bay, and, about a week later, it was reported that the shock was felt in western Greenland. The earthquake is one of much interest, for we have no record of any other in this part of the world, and the epicentre was so situated that the numerous stations in Europe, North America and Japan all lay within moderate distances from it. In response to circulars issued by Dr. A. W. Lee of the Kew Observatory, 99 records were placed at his disposal, more than two thirds of them from stations lying between 25° and 40° from the origin, and these are studied by him in a recent valuable memoir (*Meteorol. Office, Geophys. Mem.*, No. 74; 1937). The closest representation of the travel of the *P* waves to distances of 25°–50° is, he finds, given by a table based on one prepared by Gutenberg and Richter, the resulting position of the epicentre being lat. 73.3° N., long. 70.2° W., and the time at the origin 23h. 21m. 31.5s., G.M.T. The surface waves were very large, showing that the focal depth was not considerable. Indeed, from the average length (about 4 sec.) of the interval between the arrivals of the *P* and *sP* waves, it follows that the depth was about 10 km. below the surface. The apparent velocity of the *P* waves was uniform for epicentral distances from 25° to 40° and again from 45° to 50°, the velocity changing by 17 per cent from 40° to 45°. There are discrepancies between the observations of *S* and the existing tables. A new table for *S* for distances 25°–50° was, however, computed from the travel-times for *P* on the assumption that Poisson's ratio is constant for the rocks traversed by the waves, and the agreement between the observations and this table is satisfactory.

#### The Tenham Meteoric Shower of 1879

IN 1935, a collection of 102 complete meteoric stones, of aggregate weight about 108 lb., was presented to the British Museum by the widow of Mr. Benjamin Dunstan, formerly Government geologist of Queensland, who had been collecting information of the history and composition of the meteorites. This collection, described by Dr. L. J. Spencer in No. 156 of the *Mineralogical Magazine*, represents a remarkable shower that fell in 1879 at Tenham in a remote district of south-west Queensland. Thirty years ago, two large stones and one small stone (total weight, 134 lb.) from this district were acquired for the British Museum. Dr. Spencer relates the

history of these three "Warbreccan stones", which are almost certainly three belonging to the original collection made by Mr. M. Hammond, an eyewitness of the fall and who was alive in 1936. A chemical analysis of specimen stones made in the Government Chemical Laboratory at Brisbane in 1913 shows that their composition is that characteristic of the stony variety, that is, masses of crystalline rock with a small metallic content, as distinct from the type composed largely of metallic iron. This collection from the Tenham shower is stated to be the most complete example of a meteoritic shower in the British Museum collection of meteorites. Dr. Spencer describes schematically the passage of a stony meteorite through the earth's atmosphere, its stage of incandescence commencing at a height of about 100 miles; the subsequent explosion of the meteorite due to intense surface heating and to air pressure, followed perhaps by a second explosion and the fall to earth of the resulting shower of stones, the velocity of which is checked generally to that of an ordinary falling body—about 70 metres a second. In the case of a large mass of metallic iron, it will survive disintegration more easily and may arrive at the earth's surface with much greater velocity.

#### The Cannizzaro Reaction

THE mechanism of the Cannizzaro reaction, in which an aldehyde, for example, benzaldehyde, reacts with water in the presence of an alkali to give an acid and an alcohol ( $2R.CHO + H_2O = R.COOH + R.CH_2OH$ ) has been investigated by using alkali dissolved in deuterium oxide,  $D_2O$  (Bonhoeffer and Fredenhagen, *Naturwiss.*, 25, 459; 1937). No deuterium was found in the  $CH_2$  group of the alcohol. This means that the hydrogen from one aldehyde group is transferred directly to the carbon atom of the other aldehyde molecule (possibly after the two molecules have combined to give an acetal compound), without a dehydration of a hydrated aldehyde molecule and transference of molecular hydrogen.

#### Tests for Random Observations

W. O. KERMACK and A. G. McKendrick (*Proc. Roy. Soc. Edinburgh*, 57, 228; 1937), starting from an investigation of the fluctuation in the death-rate from ectromelia in mice in an experimental epidemic, have arrived at simple tests which will help to decide whether a series of numbers is *random*, that is, due to mere chance, or evidence of a real cause. A series which conforms to these tests is not necessarily random, but is likely to be so. On the other hand, failure to conform is evidence of non-randomness. The calculation depends on the *runs* and *gaps*, the average lengths and standard deviations of which are compared with what would be expected from pure chance. One obvious limitation of the tests is that they make use only of qualitative relationships and do not take into account exact magnitudes, so they do not make full use of the information available. On the other hand, there is the compensating advantage that no assumption is made about the law of distribution of the observations. These tests are applied to some examples, including Tippett's random numbers, telephone numbers, duration of measles epidemics, Swedish death-rates, Edinburgh rainfall and Edinburgh temperature. The results work out as might be expected in most cases, but the Edinburgh climate seems to defy prediction.



## The First International Acoustical Conference

THERE is scarcely any subject which, during the last few years, has assumed greater commercial and social significance than acoustics. Alongside has come the steady growth of noise—that is, unwanted sound—which in its many aspects is beginning to stir the consciousness of the public to such an extent that it is demanding measures for relief in the more outstanding cases. Acoustics has furthermore developed a large specialized terminology, and the need for agreed measuring units and standards has become more and more pressing.

In Great Britain such questions have been dealt with by a British National Committee under the auspices of the British Standards Institution. Under the chairmanship of Dr. G. W. C. Kaye, this Committee has developed and classified an extensive glossary of acoustical terms\*, particular attention being given to units and standards, among them the scales and units of loudness and energy-level. As regards these latter, which are of especial importance, considerable divergencies have unfortunately prevailed in the practices of different countries, not only as regards the scales, units and zeros of the standard reference tones, but also in the listening techniques and phraseology employed. In its work, the British Committee kept in mind the desirability of eventual international agreement in such matters and to this end set up specifications dealing with the standard reference sound (a sinusoidal plane progressive wave of a frequency of 1000 cycles per second), and the arbitrary zero of reference (0.0002 dyne per sq. cm.). The "phon" (a name we owe to Barkhausen) was adopted as the unit in the subjective scale of equivalent loudness, while the use of the "decibel" (a name which originated in America) was restricted to the scale of the associated energy or pressure level.

In July of this year, the first international conference on acoustics was summoned in Paris under the auspices of the International Electrotechnical Commission (I.E.C.), some sixty delegates from

\* "British Standard Glossary of Acoustical Terms and Definitions" (London: British Standards Institution, 1936) 3s. 6d. net.

thirteen countries assembling under the presidency of M. Duval, president of the French Electrotechnical Committee. Substantial agreement was reached in the several sections set up to deal with vocabulary, fundamental units and methods of measurement, electro-acoustics, and noise abatement. Chief interest centred in the questions of fundamental units and methods of measurement, and it is satisfactory to learn that the proposals eventually adopted are in complete agreement with the specifications submitted by the British delegation under the chairmanship of Dr. Kaye. The "phon" and the "decibel" are accordingly accepted as international units, so that an important contribution to international acoustical measurements has been achieved. Particular mention should be made of the helpful and conciliatory outlook of the United States and German delegations, of whom Dr. Harvey Fletcher and Dr. Grutzmacher were the respective chairmen.

An inquiry into the present position of objective noise meters indicated that while great progress had been made, there was not enough experience available to approve at the present juncture the specification and standardization of a 'universal' noise meter which will measure on the phon scale any and every type of sound. Other points dealt with included the standardization of methods of testing microphones and loud-speakers, the different procedures adopted in various countries for measuring acoustic absorption coefficients by the reverberation method, the methods used to investigate the transmission of air-borne and impact sounds in buildings, and the steps taken in different countries for reducing noise.

The pronounced success of the Conference owed much to the valuable preparatory work of the I.E.C. and the co-operation of M. Valensi, secretary of the Comité Consultatif International Téléphonique. It was agreed at the final plenary meeting that the work of future conferences should be administered by the Federation of National Standardising Bodies known as the International Standards Association, the I.E.C. concurring and actively collaborating.

## Concentration of Solutes in Vacuolar and Cytoplasmic Saps

By Dr. E. Phillis and Dr. T. G. Mason, F.R.S.

IF 25–30 gm. of mature leaves of the cotton plant are rolled up, wrapped in cloth, the wad placed between two disks about 2 in. in diameter and the whole put in the jaws of a small vice, sap is expressed on the application of pressure. As the sap flows out of the wad, much of the leaf is squeezed out from between the disks. To obtain more sap, the tissue must be collected into a ball and again wrapped up in the cloth. On the application of pressure, sap is again expressed. This process can be repeated three or four times; but a point is reached when even

under the greatest pressures that can be obtained in the vice, the yield of sap amounts to only a few drops. If now the residue from which sap has been expressed is frozen at  $-16^{\circ}\text{C}$ . and then thawed, much more sap can be obtained on the application of very small pressures.

It was observed by Dixon and Atkins<sup>1</sup> that the concentration of solutes increased in successive fractions. They also discovered that preliminary treatment of the leaf by freezing or by exposure to anaesthetics greatly increased the concentration of



solutes over that in sap expressed from untreated tissue. Typical results from our own experiments for calcium, magnesium and potassium are shown in Table 1.

TABLE 1. SAP EXPRESSED IN VICE.

		No. of fractions			Frozen residue
		1	2	3	
ml. sap from 100 gm. fresh wt.		11.2	11.4	12.7	28.6
Concentration (mgm. per 100 gm. water)	Calcium	490	525	568	848
	Magnesium	54.4	57.3	61.2	99.7
	Potassium	201	218	238	264

It will be seen that much sap was released and that there was a marked increase in the concentration of solutes as a result of freezing the residue. The usual explanation (Walter<sup>2</sup>) for the increase in concentration in successive fractions is that pressure has two effects, one being the expression of water through the cytoplasm and its membranes, solutes being retained in the vacuole, and the other the bursting of cells and consequent liberation of vacuolar solution. The change in concentration in successive fractions is assumed, therefore, to be due to filtration of water and concentration of the vacuolar solution. The increased concentration resulting from freezing is generally interpreted as due to the breakdown of impermeable membranes and the release of the vacuolar sap. It is very commonly assumed by botanists (Scarth and Levitt<sup>3</sup>) that the cytoplasm in mature leaves contributes but little sap and that the bulk of the sap expressed even from previously frozen tissue comes from the vacuole. Perhaps it is also true that many botanists still believe that the continuous phase of cytoplasm is water (cf. Stiles<sup>4</sup>), and that some of this water may be expressed, particularly after coagulation of the cytoplasm which is assumed to occur as a result of freezing.

Somewhat to our surprise, we have observed that if leaves are carefully placed one on top of another between the relatively large plates of a hydraulic press, the concentration of sap in successive fractions does not necessarily increase as the pressure is increased. The concentrations are also found to be lower than when leaves are pressed in the usual way in the vice. In the hydraulic press, using carefully arranged leaves, they are not squeezed out from between the plates, and the shearing forces that arise in the vice, as leaves are redistributed in the wad as its shape is changed, are negligible or absent. The presence or absence of shearing forces appears to be crucial. The results for a duplicate sample of leaves to that used in Table 1 are shown in Table 2.

TABLE 2. SAP EXPRESSED BY HYDRAULIC PRESS.

		No. of fractions			Frozen residue
		1	2	3	
Pressure (lb. per sq. in.)		6,000	10,000	16,000	16,000
ml. sap from 100 gm. fresh wt.		13.1	13.5	11.6	28.5
Concentration (mgm. per 100 gm. water)	Calcium	420	414	424	886
	Magnesium	46.9	44.5	46.5	107.2
	Potassium	162	181	176	253

It will be seen that there is again a great increase in concentration when the residue is frozen and pressure applied. Of outstanding importance is the fact that the concentration remains nearly constant and does not rise as the pressure is increased. There is thus no support for the view that water is filtered under pressure through the cytoplasm. Other causes for the increase in concentration in the vice must therefore be sought. It will be noticed that even the first fractions in the vice exceeded those in the hydraulic press. If the results are graphed, it will be seen that the curves for the two methods of expressing sap diverge from a common origin. It is noteworthy that even under pressures so high as 16,000 lb. per sq. inch, only approximately half the sap was expressed.

The meagre proportion of the total sap present in the leaf that can be expressed by these high pressures does not indicate that the continuous phase of cytoplasm can be water, as is generally assumed, for as much water can be expressed from a gelatin gel under a pressure of 2,000 lb. per sq. inch as is liberated<sup>5</sup> by freezing at  $-20^{\circ}$  C. It must be borne in mind that nearly half the volume of the mesophyll cells in cotton, excluding the cells' walls, consists of cytoplasm. This is contrary to what is usually believed to be the case (cf. Stiles<sup>4</sup>); but Iljin's<sup>6</sup> measurements show that cotton is by no means exceptional in this respect. It would seem that the continuous phase of active cytoplasm, as Lepeschkin<sup>7</sup> suggests, is a liquid, composed probably of proteins, lipoids and water. This liquid, as we have previously<sup>8</sup> suggested, would appear to have solubilities and diffusion constants quite different from those of water, and to be dependent for its origin and maintenance on respiratory energy. With such a concept of the composition of the continuous phase of cytoplasm, the results already described would be explained as follows.

When the leaf is pressed in the hydraulic press, the vacuolar sap escapes through fissures in the cytoplasm. The continuous phase of the cytoplasm, for which Lepeschkin has proposed the term 'vitaid', is not decomposed by this direct pressure into its component parts. In the vice, on the other hand, shearing forces are operating. We thus assume that the 'vitaid' molecule is decomposed by comparatively small shearing forces though able to withstand direct pressures of considerable magnitude. Thus in the vice a gradual decomposition of the 'vitaid' molecule occurs. It is broken up into proteins, lipoids and water, while the solutes which were in solution in it are now dissolved in the water and escape with the vacuolar sap, which in the leaf of the cotton plant is considerably more dilute than the sap that is produced as a result of the decomposition of the 'vitaid' liquid. The great increase in concentration and the large amount of sap produced when the residue from the hydraulic press is frozen is due to the decomposition of the 'vitaid' liquid by the shearing forces that arise as a result of the formation, and perhaps the disappearance, of ice in the vacuole and the intercellular spaces.

Some confirmation of this hypothesis is furnished by the following experiment, the results of which are shown in Table 3. If the residue from the hydraulic press from which all the sap available at a pressure of 14,000 lb. per sq. inch has already been expressed, is divided into two portions, one of which is frozen and one of which is gently rubbed between the fingers and thumb, it will then be found that further



sap can be expressed from each portion merely by squeezing in the hand. The volume obtained after rubbing, as might be expected, is slightly less than that after freezing, for the shearing is less thorough. The concentrations in the two residue saps were approximately equal in this experiment, although in other experiments, those in the finger-rubbed fractions have been slightly below those in the frozen fractions. The maximum pressures used give no indication of the ease of expression of sap. From the fresh tissue, no sap was obtained below a dial reading of 4,000 lb. per sq. inch hydraulic pressure, while with both the residues, most of the sap was expressed before the needle left the zero mark.

TABLE 3. EFFECT OF PREVIOUS TREATMENT OF RESIDUE ON SAP OBTAINABLE UNDER PRESSURE.

	Fresh leaves	Treatment of residue	
		Finger-rubbed	Frozen
Maximum pressure (lb. per sq. inch)	14,000	14,000	14,000
gm. sap from 100 gm. fresh weight	24.4	30.9	36.7

Concentration (mgm. per 100 gm. water)		Fresh (hydraulic pressing)	Residue treatment	
			Finger-rubbed	Frozen
	Calcium	266	718	712
	Magnesium	44.0	104.7	106.6
	Potassium	275	599	604

It is interesting to note that Audus<sup>9</sup> has found that rubbing a leaf on both sides with a finger stall or merely bending the leaf increases respiration 2-3 fold.

If we are correct in the interpretation of the results, we can form *approximate* estimates of the

concentrations of solutes in the vacuole and cytoplasm respectively. The vacuolar estimate is obtained from the lowest concentration obtainable by direct pressing. This may be an over-estimate, for slight shearing forces will cause some cytoplasmic decomposition; for example, when brittle leaves are pressed in the hydraulic press, successive fractions of sap show diminishing concentration, due, we believe, to shearing forces developed in the leaf mass during the initial stages of compression. The action of such shearing forces is associated with the presence of chloroplasts in the expressed sap. If the vacuolar sap could be completely expressed the residue should, on decomposition, yield a sap representative of the cytoplasm, but incomplete vacuolar pressing will cause dilution of the cytoplasmic sap and an under-estimate of its concentration. In the leaves used in the experiment just described, the concentration in the cytoplasm must have been more than double that in the vacuole.

Methods used for the extraction of sap invariably include some process which we believe leads to destruction of the 'vitoid'. These processes include boiling<sup>2</sup>, freezing, grinding<sup>10</sup> and treatment with anaesthetics<sup>11</sup>. All saps obtained by these processes are, therefore, mixtures of vacuolar sap with that produced on decomposition of the vitoid. It will be necessary in the future, we think, to distinguish between the true (vacuolar) sap and that derived from the destruction of the cytoplasm.

<sup>1</sup> Dixon, H. H., and Atkins, W. R. G., *Proc. Roy. Soc. Dub.*, **13**, 422 (1913).

<sup>2</sup> Walter, H., *Ber. deut. bot. Ges.*, **46**, 539 (1938).

<sup>3</sup> Scarth, G. W., and Levitt, J., *Plant Physiol.*, **12**, 51 (1937).

<sup>4</sup> Stiles, W., "Introduction to Principles of Plant Physiology". (London, 1936).

<sup>5</sup> Jordan, Lloyd D., and Moran, T., *NATURE*, **132**, 515 (1933).

<sup>6</sup> Iljin, W. S., *Bull. de l'assoc. Russe pour les recherches scientifiques à Prague*, **1** (VI). Sec. des sciences naturelles et mathématiques. No. 4 (1934).

<sup>7</sup> Lepeschkin, W. W., *Biodynamica*, **19** (1936).

<sup>8</sup> Mason, T. G., and Phillis, E., *Bot. Rev.*, **3**, 47 (1937).

<sup>9</sup> Audus, L. J., *New Phyt.*, **34**, 386 (1935).

<sup>10</sup> Sayre, J. D., and Morris, V. H., *Plant Physiol.*, **7**, 261 (1932).

<sup>11</sup> Chibnall, A. C., *J. Biol. Chem.*, **55**, 333 (1923).

## International Congress for Short Waves in Physics, Biology and Medicine, Vienna\*

PROF. H. THIRRING, in an address made during the opening ceremony of the Short Wave Congress held in Vienna on July 12-17, referred to the many fields of application of Hertzian waves in research, medicine and radio technology. These fields are to some extent interdependent, and there are in particular medical and biophysical problems which require the collaboration of biologists, physicists and radio-engineers if they are to be solved satisfactorily. Thirring pointed specially to the urgent problem of dosage measurement in short wave therapy and to the fundamental scientific question of the mode of biological action of short waves: specific or thermal. These problems occupied a prominent position in the Congress, and, together with purely physical papers, will form the substance of the

\* Internationaler Kongress für Kurzwellen in Physik, Biologie und Medizin. Referate und Mitteilungen. (Wien: Brüder Hollinek, 1937).

present report; the review articles in the various sections and the fifty or so papers in the medical section will not be dealt with. (Number in brackets in each heading indicates the number of papers presented.)

(1) *Production of ultra-short waves* (11). Most of the papers dealt with retarding field or magnetron circuits devised for production of the shortest waves; the most interesting perhaps was the 14 cm. wave retarding field generator with resonant cavity as frequency stabilizer, demonstrated by Dällenbach, Alderding and Kleinsteuber. The demonstration showed the remarkable frequency stability attained and the modulation of the 14 cm. wave. Another retarding field system was described by Meng and Potapenko, who have constructed exceedingly symmetrical micro-tubes for high-order oscillations of wave-length  $\sim 1$  cm. McArthur described a new



magnetron, of single (water-cooled) anode type with permanent magnet and concentric tube transmission line, giving 10 watts at  $\lambda$  4.8 cm. Groszkowsky and Ryzko discussed the increased efficiency obtainable with 4-anode magnetron tubes when the usual tungsten cathode is replaced by oxide-coated nickel. The Okabe electron beam magnetron was described by Joji Ito.

(2) *Transmission: Ionosphere research* (12). Van der Pol sketched a theory of propagation of ultra-short waves over the earth, starting from the Maxwell equations, with proper boundary conditions; he showed that 7 m. waves must diffract considerably beyond the horizon, with a strong attenuation which is due to absorption by the ground. Southworth discussed transmission in pipes or cylindrical rods of dielectric. For a hollow metal pipe the diameter must be at least  $0.58\lambda$ . The resonant cavity is a special case of this system, and may be used as a frequency determining unit or as an impedance matching device, and perhaps as a new means of 'irradiating' laboratory specimens.

Six of these papers dealt with the ionosphere, beginning with a review by Zenneck. Burkard discussed the information concerning the ionosphere and its diurnal and seasonal variations obtained from a statistical treatment of amateur radio reports—as many as 10,000 per month. Reports for the summers 1934 and 1935 (sunspot minimum—single reflection, presumably from  $F_1$ ) gave 240 km. as the mean height of the layer. Ito Yoji described ionosphere studies during the total eclipse of June 19, 1936, when there was found 47 per cent decrease in electron density in  $F_1$ , but practically no effect on  $F_2$ . Fuchs described a method of determining the absolute temperature in the ionosphere, obtaining the values  $F_1 > 400^\circ$ ,  $F_2 > 1,400^\circ$  K., so that the daily division into the two layers is presumably due to gas-thermal effects. Hals described the discovery of the Hals-Störmer echoes, and Fuchs provided an interpretation, as an ultra-violet ionization phenomenon of the upper atmosphere.

(3) *Absorption and dispersion in chemical systems* (4). Potapenko described a new modification of the Drude-Coolidge method for determination of  $\epsilon'$  and  $\epsilon''$ ; together with Keutner, he has used the method for measurement on monohydric alcohols and glycerol, finding, as others have found, approximate agreement with the Debye theory. Williams has measured the absorption of 1.25 cm. waves by ammonia gas, the ray being diffracted from an échellette grating after passage through the gas, and the intensity being determined with a crystal detector.

(4) *Dielectric properties of tissues: heat production in tissues and tissue models* (4). The papers on this subject brought out clearly the large number of factors which must be taken into account in considering the possibility of selective heating of tissues by ultra-short waves. Given fixed values of  $\epsilon$  (dielectric constant) and  $\kappa$  (specific conductivity) for the various parts of a body, the matter is relatively simple; if, however, both  $\epsilon$  and  $\kappa$  are strongly dependent on frequency and on temperature, the calculation of the optimal wave-length for selective heating of a certain tissue becomes impossible without complete experimental dispersion curves for all the tissues concerned. In regard to  $\kappa$ , Schaefer and Rajewsky have now extended their measurements on blood to several other tissues, while an admirable series of measurements by K. Osswald shows the dependence of both  $\epsilon$  and  $\kappa$  on frequency even in the

ultra high-frequency region. A further complicating factor may be the very large effect of field intensity on dipole losses in solutions of *zwitterions*, observed by Schmelzer in the case of tetra-*n*-butylammonium bromide in benzene, although it is not yet known what proportion of the observed high-frequency conductivity of tissues is due to substances of this type.

This complexity in the physical properties of heterogeneous systems makes it important to obtain empirical information concerning selective heating by experiments with 'models', however approximate such information may be. Pätzold described measurements of the relative heating of juxtaposed layers of fat and muscle in the condenser field at  $\lambda$  6 m. and 1 m., the results of which are in substantial agreement with those calculated from Osswald's data. He has also measured the relative heating of layers of salt solutions in a solenoidal field as a function of position, wave-length and number of coil windings, and further considered the possibility of applying ultra high-frequency energy by 'irradiation', on the basis of *Halbwertschicht* determinations on salt solutions and tissues at  $\lambda$  4.3 m.

(5) *Physics and chemistry of possible specific (non-thermal) effects* (17). It soon became clear that 'non-thermal' effects might be placed in several categories: (a) Specific electrical and mechanical effects, the existence of which, in principle, can scarcely be doubted, resulting in chain configuration of suspended particles, in decreased degree of dispersion, change in viscosity, etc., dependent on field strength and type of field but not on frequency. These effects were admirably discussed by Krasny-Ergen. (b) Possible specific chemical and biochemical effects, the existence of which has not yet been satisfactorily demonstrated, although frequently asserted. These were discussed by Königer, who suggested possible 'resonance' absorption effects, in the sense of Romanoff's theory. Bateman and Rosenberg discussed the physical conditions which have to be satisfied for the experimental elimination of thermal effects. (c) Possible non-thermal physiological effects on cell suspensions, when thermal effects can be avoided by use of proper experimental conditions. According to Hasché, Leunig and Loch, the field has no effect on *B. coli* and *Staph. pyocyanus aureus* under most conditions of wave-length, intensity and type of suspension medium, although a few inconsistent observations have been made at  $\lambda$  3.5 m.; similar negative results were obtained by Ruete with *B. coli* and several moulds, and by Malov, with *Drosophila* (mutation rate and lethal action). The observations of Roth (development of exposed seeds), of Wertheim ('biopositive' effects on yeast) and of Schweinburg (on rabies virus), with their less satisfactory control of heating, do not necessarily contradict these negative results. (d) Effects on large bodies: 'specific' effects opposite to 'heating' effects. Most of the observed physiological effects belong in this category; they could be the result of (a) or (b), or else—more probably—merely thermal effects of a special kind, due to the peculiar distribution of temperature gradients in the body which results from exposure to the field. None of the many experiments of this type described at the Congress contributed essentially to the solution of the problem.

(6) *Measurement of absorbed energy in ultra-short wave therapy* (9). The difficulties of a satisfactory measurement of 'intensity' (watts absorbed/sec.) were enumerated by several contributors, and a number



of modifications of known procedures were described. In particular, Mittelman has used a method involving the preliminary determination of the effective resistance of the circuit with a secondary transmitter and valve voltmeter, followed by measurement of  $I$  or  $E$  during treatment with thermo-cross and dynamometer. Riesinger measures the total anode dissipation of his transmitter with ammeter and voltmeter, and the heat dissipation with a photo-cell and a reflecting bimetal strip fixed to the anode, the difference representing the high-frequency energy

generated. It seems, however, uncertain whether this arrangement can be used, as Riesinger claims, as a dose intensity indicator. Schwarz suggested two rapid methods: first, determination of 'spread' of the resonance curve by means of variable condenser and Braun tube; secondly, measurement of true field across the object by small electrometer electrodes mounted in the condenser plates. The papers on the subject gave the impression, however, that the problem is still far from being solved.

J. B. BATEMAN.

## The Science of Archives in South Africa\*

**S**TUDY and work connected with archives have been recognized as a science, and a scientific system of keeping archives has been evolved; while not only is a high standard of attainment and a wide range of knowledge of scientific method and results demanded of the archivist, but also in certain European countries provision has been made for his technical training.

Archives constitute a fundamental source of historical information, and hence the introduction of the moving picture—the cinematograph film and the 'talkies' have, in the problem of their conservation, forced on the attention of the archivist a number of practical questions, the method of dealing with which has yet to be determined on scientific lines.

In South Africa, prior to the date of the Union, the Cape Province gave attention to this subject more than half a century ago, and the Transvaal since about 1902. In 1919 the Union Government took the first serious step in co-ordinating the archives of the four provinces.

The administration of Union and Provincial Archives was centralized in a chief archivist, and by legislation of 1922 Union and Provincial archive depots were created, the former at the seat of government of the Union, and the latter at the seat of the Provincial administration. The centres thus are in Cape Town, Pretoria, Pietermaritzburg and Bloemfontein, each in charge of an archivist, and the whole administration centralized in the chief archivist. This system secures uniformity of administration, arrangement, classification, inventorying, methods of preservation and general care. It has resulted in straightforward administrative efficiency, and experience has taught that it is the only satisfactory method. Experts in archive economy the world over endorse this system.

The Archives Department is a young branch of the Public Service of the Union of South Africa. Its advance, unspectacular but steady, during the last decade or so, was marked by a persistent claim to recognition as an integral part of the Government machinery and the necessity for its personnel to be men with a certain standard of education and an aptitude for the work.

An archives depot is not static, and must increase in quantity and quality as the years pass. The

Department was conceived, no doubt, as a branch of the service with great possibilities. Its growth was slow at first, and to some extent stunted because it had to overcome many prejudices. When it was given a place in the Government machinery, it had to live down the prevalent conception that it was a warehouse for the storage of records with someone in charge to keep them from deterioration and permit their consultation when necessary. It had to have a proper home and the right kind of vitamins in its food to allow it to develop. But this stripping of a department struggled on, facing all the obstacles which beset it.

South Africa had the advantage of studying the systems of similar institutions of older and more experienced countries. It avoided the pitfalls made by them in the past and took the best from each country and adapted this to suit the conditions in South Africa. Other sections of the British Commonwealth of Nations afterwards gave attention to the organization of their national records, such as the Commonwealth of Australia and the Dominion of New Zealand. The most recent recruit is the Colony of Southern Rhodesia, which created an Archives Department by legislation a few years ago. From the three countries, inquiries came to South Africa regarding the system of keeping archives which was being adopted.

Within the last ten years, the archives at Cape Town, Pietermaritzburg and Bloemfontein have been transferred to their buildings with up-to-date equipment and protective devices at a cost of many tens of thousands of pounds. Steps are being taken to provide a separate building at Pretoria, which will house the Provincial archives and contain the records of the Union Government, when old enough for the transfer so laid down by law.

To illustrate the growth of this branch of the service during the last eighteen years, personnel and salary expenditure have increased from a staff of five and an expenditure of £2,800 in 1919, to a staff of 42 and an expenditure of £11,000 in 1937. The number of researchers and visitors and volumes consulted during the last five years indicates a steady and encouraging increase.

The system for the arrangement and classification of the archives in South Africa is that recognized in Europe, and referred to as the 'principe des fonds', in which the system of classification is based on the department of origin. Experience has shown that this is the only sound one.

\* Substance of the presidential address to the South African Association for the Advancement of Science, at the Windhoek meeting on July 5, 1937, by Lieut.-Colonel C. Graham Botha, chief archivist of the Union of South Africa.



Colonel Botha described the duties of the archivist in relation to arrangement, classification, inventory and catalogue, and touched upon the physical defence of archives, covering the repository and accommodation, and their moral defence, referring to their reception and arrangement, in which he must study the administrations concerned, their history and organization, and divide them into classes and subdivisions of these; while the secondary duty of the archivist relating to the special requirements of the student covers the preparation of guides, lists, inventories and catalogues of his archives. Full transcripts must be prepared and published under an editor to meet the needs of the student resident at a distance. He also dealt with the problem of selection and destruction.

Finally, in illustration of his contention that archives are the material of history, Colonel Botha outlined from the records preserved in the archives, the history of the national roads in South Africa, the creation of a national road fund, and the constitution of a National Road Board in 1935, of which the story is disclosed in the archives by records of South Africa's early road system and its administration from the seventeenth century onward.

In conclusion, the science of archives may be likened to a venerable sage, who seeks for the authentic traces of man and his doings in the past and, finding them, preserves and jealously guards them. His eyes are glowing with wisdom drawn from the mass of evidence of man's past accomplishments, his failures and successes, as treasured up by him with tender care; ever ready to reach a helping hand to men of the present day in their struggles to move onward the ship of human progress, often doing so with an encouraging smile and reference to the Solomon of Biblical times: "there is nothing new under the sun"; and he appeals insistently to one and all to view the present unfolding of our grand and wonderful universe in the light of the ages gone by.

## Science News a Century Ago

Lyell in Germany

WRITING from Wesel on the Rhine on August 29, 1837, to Darwin, Lyell said, "I write this to you, at least I am beginning it, in a steamboat on the Rhine, so make allowance for the tremulous motion. We came in a steamer from Copenhagen to Lübeck, then in a hired carriage to Hamburg, across the sand and boulder formation of the Baltic, which for the most part we have been on ever since, although we have crossed the Weser, and Ems, and Lippe. The blocks of red syenitic granite, which I hammered away at in Norway, and which I saw there *in situ* sending its veins into the trilobite and orthoceratite schist, have been carried with small gravel of the same, by ice of course, over the south of Norway, and thence down the south-west of Sweden, and all over Jutland and Holstein, down to the Elbe, from whence they came to the Weser, and so on to this or near this. . . .

"This then was already dry land when Holstein, and all from the Baltic as far as Osnabruck or the Teutobarger Wald hills, was submerged. At Bremen I saw Olbers, aged seventy-two, the astronomer who discovered Pallas and Vesta, and at Osnabruck and Münster I met a warm and German reception from men of whom I had never heard, who had read

my paper on Sweden or something else. I mean by German, that kind of frank expression of enthusiasm for science, or of any emotion, which a well-bred Englishman tries to suppress, at least all outward expression of it, from the dread of being thought ridiculous, or of affecting to feel more than he does, or from *mauvaise honte*. If you ever get sick of that fashionable nonchalance which would blush to admire anything, or at least to confess it, I advise you to plunge into Germany, and you will be soon refreshed and brought back to the right tone again, whether it be literature, science, or any other pursuit you are following. . . ."

## The First Steam Frigate

ON August 31, 1837, H.M.S. *Gorgon*, the first steam vessel in the Royal Navy designed as a frigate, was launched at Pembroke. Designed by Captain (afterwards Admiral) Sir William Symonds, the Surveyor of the Navy, the *Gorgon* was 178 ft. long, 37½ ft. beam and 1,108 tons burthen by the rule known as Builders' Old Measurement. She was noteworthy not only as being designed as a frigate, but also as being the first vessel in the Navy to be fitted with John Seaward's direct-acting engine, instead of a side-lever engine, by which a considerable saving of weight was effected. The cylinders were placed directly beneath the crankshaft driving the paddle wheels. They were 64 in. diameter with a stroke of 5½ ft., the engine being of 320 nominal horse-power. The boiler pressure was 5 lb. per square inch. The total weight of the machinery, including the water in the boilers, was 276 tons. Service in such vessels was eagerly sought after by far-sighted young naval officers, and among those who served in the *Gorgon* was Admiral Sir Astley Cooper Key, who as a lieutenant exchanged from the *Curaçoa* into the *Gorgon* and in doing so spoke of it as almost a change of profession. "Being in a steamer", he wrote, "has given me a much greater interest in the service than I had before, from having, I suppose, an object in view to which I feel myself suited." On another occasion he wrote, "I study De Pambour and Tredgold daily".

## The British Association at Liverpool

IN its issue of September 2, 1837, the *Athenæum*, referring to the forthcoming meeting of the British Association at Liverpool, said that while there had been no doubt as to the really excellent fruits of the morning meetings, the same satisfaction had not been felt regarding the evening meetings, which had been intended for diffusing among the general body of members "some part of the treasures of knowledge collected and purified in each Section". There was therefore to be a change of plan. "The great want of opportunity for cultivating mutual acquaintance and enjoying friendly discussion—a desideratum felt with increased force at every Meeting succeeding the embryo sitting at York—will be met by devoting at least two evenings to a pleasurable Promenade and Conversazione in the magnificent apartments of the Town Hall, which the Mayor and Council have most liberally placed at the disposition of the Association. Thus the evenings may offer an agreeable relaxation after the morning work—the men of abstract and practical knowledge may be mingled together, and both brought into friendly intercourse with those numerous friends of the Association who attend the meetings to gather knowledge, and those whom they esteem as leaders of science."



## Societies and Academies

## Dublin

Royal Dublin Society, June 22.

H. G. WAGER and ELIZABETH M. WAGER: Annual changes in the osmotic value of some arctic and temperate plants. Determinations of the osmotic value of some arctic plants were made at intervals throughout the year in Kangerdlugssuak, East Greenland, during the course of the British East Greenland Expedition, 1935-36. The changes in the osmotic value have been correlated with the climate of the district.

MARGARET MOHAN, J. KEANE and T. J. NOLAN: The chemical constituents of lichens found in Ireland: *Parmelia conspersa*, Ach. While the Japanese and European varieties of the lichen have been found to contain salazic acid, the Irish lichen, collected at Howth, Co. Dublin, has been found to contain stictic acid. All three varieties also contain usnic acid.

J. H. J. POOLE: A synchronous clock time-marker. The movement of a synchronous electric clock forms a cheap and convenient motor for causing a disk with slits to rotate once per minute and thus provide a series of light-flashes at convenient intervals to form a time base on a photographic film recorder.

H. H. POOLE: A convenient form of galvanometer shunt for use with rectifier photo-cells. A constant resistance shunt of the telephone attenuator type, giving ratios 1, 5, 10, 50, 100 and 500, with an external resistance 10 ohms on every range with a 10-ohm galvanometer, is very suitable for daylight measurements. The use of spring keys to bring either of two cells into circuit and then to increase the sensitivity by successively cutting out the shunts saves the sensitive galvanometer from accidental damage. A reversing key doubles the sensitivity for small deflections.

Royal Irish Academy, June 28.

K. JESSEN and A. FARRINGTON: The bogs at Ballybetagh, with remarks on the development of late-glacial deposits in Ireland. An investigation of the well-known deposits near Dublin containing remains of *Cervus giganteus*. A detailed description of the deposits is given with a list of plants identified in the late-glacial and early post-glacial beds. Pollen diagrams from several points are discussed. Comparison is made with deposits found in other basins, for example, at Ralaghan, Co. Cavan, and a general view of late-glacial conditions in Ireland is suggested.

## Brussels

Royal Academy (*Bull. Classe Sci.*, 23, No. 5; 1937).

G. CESÀRO and J. MÉLON: The crystalline form of aconite.

P. GÉRARD: The renal elimination of acid colouring matters in *Astacus fluviatilis*.

M. KOURENSKY: The integration of linear partial differential equations of the first order of two and more than two unknown functions.

N. NERONOFF: Reduction of a plane problem in hydrodynamics to the solution of a system of functional equations (2).

S. AREND: Direct calculation of the relationships used in positional astrophysics.

F. E. NISOLI and J. GÉRARD: New determination of the vertex of the cluster in Taurus and of the star stream in Scorpius.

M. G. E. COSYNS: Variation of the specific primary ionization of hydrogen as a function of the energy of the incident electrons.

## Geneva

Society of Physics and Natural History of Geneva, June 17.

G. BILGER: The potential of polygons and elementary geometry. The author demonstrates the following propositions: (1) All regular homogeneous regular polygons having the same vertices and the same mass create the same logarithmic potential of the simple layer in the connex domain of the point at infinity. (2) All homogeneous semi-regular polygons, inscribable, having the same vertices, in each vertex the same bisector and the same mass, create the same logarithmic potential of the simple layer in the connex domain of the point at infinity.

G. CARRISSON: Rapid counting of a microbial suspension. The author describes a method, based on the absorption of light by the bacteria, for counting bacteria in suspension. The quantity of micro-organism in 1 c.c. can thus be determined in about ten minutes to approximately 1 in 10<sup>6</sup>. The measurement is made with a Lange photo-electric colorimeter.

## Moscow

Academy of Sciences, *C.R.*, 15, No. 2; 1937.

V. S. IGNATOVSKIY: The Laplacean transformation (6).

A. P. DIETZMANN: The *p*-groups.

S. G. NATANSON: The use of the photo-relay in the study of lunar micro-relief.

A. D. PETROV and M. A. CELČOVA: The catalytic isomerization of normal hexene and octene in the presence of zinc chloride and phosphoric acid.

V. A. DEVYATNIN and V. M. IOSIKOVA: The determination of ascorbic acid (vitamin C) in blood and urine.

K. S. MASLOV and I. A. KOROBKOV: Discovery in Juria of Upper Eocene characterized by its fauna.

J. A. PETROKOVIČ: The phosphorite-bearing horizon of the Mangysplak Triassic.

F. V. ČUCHROV: Antlerite of the Krestovozdvizhensk region in Djeskagan.

Y. M. OLENOV, I. S. KHARMAC, K. T. GALKOVSKAYA, N. I. KNIAZEVA, A. D. LEBEDEVA and Z. T. POPOVA: Natural selection in wild populations of *Drosophila melanogaster*.

L. I. DŽAPARIDZE: The anatomical connexion between the acerose leaf and the pitch-carrying system of the wood in *Pinus* sp.

## Rome

National Academy of the Lincei (*Atti*, 24, 393-487; 1936).

L. TONELLI: (1) Problem of Plateau (2). (2) Semi-continuity in the problems of Mayer and of Lagrange.

O. M. CORBINO: Method of calibrating the electrostatic microphone based on its behaviour towards an alternating electromotive force.



C. BARBA: Definite polynomials (1). Fundamental problems.

R. CACCIOPOLI: Branched inverted functional correspondences: general theory and applications to some non-linear functional equations and to Plateau's problem (2).

E. LEVI: Characteristic properties of Laplace's transformation.

G. ARRIGHI: Isocarene oscillations about the configurations of general equilibrium (2).

E. GUGINO: Variational problem which assumes prefixed trajectories.

C. JACOB: Bifurcation of a liquid jet due to a circular obstacle.

L. SONA: Translo-circulatory current in presence of an obstacle formed by two crossed laminæ.

G. BOAGA: Localization of a spherical body by means of Eötvös measurements.

A. BARONI: Electron diffraction study of the graphitization of some industrial lamp-blacks.

A. IANDELLI and E. BOTTI: Crystal structure of the compounds of the rare earths with the metalloids of the fifth group. Phosphides of lanthanum, cerium and praseodymium (1).

G. NATTA and L. PASSERINI: Dimorphism of white phosphorus.

F. RODOLICO: Granular forms of melilitic rocks.

G. NEGODI: Further contributions to the cariology of the genus *Fumaria*.

W. JABLONSKI: Survival and mitosis of free epithelial cells *in vitro*.

G. LOLLI: Thyroid function and experimental alcoholæmia.

E. SERIANNI: The action of morphine on the curve of experimental alcoholæmia in the normal man.

### Sydney

Royal Society of New South Wales, June 2.

ADOLPH BOLLIGER: Compounds of creatinine with alkali hydroxides. In an alcoholic medium, creatinine forms with sodium, potassium and rubidium hydroxide, crystalline compounds which can be readily isolated and which may consist either of one molecule of creatinine, one of alkali hydroxide and one or two of water, or of one atom of alkali and two or three molecules of water.

G. F. K. NAYLOR: A preliminary note on the occurrence of Palæozoic strata near Taralga, N.S.W. Recent investigations near Taralga have shown that Palæozoic sedimentation is represented in that area by Upper Ordovician, Upper Silurian and Upper Devonian strata, their respective ages being determined conclusively by the presence of fossils. The general rock pattern conforms to, and is continuous with, that previously determined in the Goulburn district. An interesting point is the finding of black shale containing *Monograptus bohemicus*, interbedded with highly fossiliferous Upper Silurian limestones. This indicates that the latter are of Lower Ludlow age, and owing to the restricted range of that graptolite, may lead to a more exact correlation of N.S.W. Silurian rocks with British and Victorian occurrences than has hitherto been possible.

A. J. BIRCH: The detection and estimation of  $\alpha$ -phellandrene in essential oils. This paper describes an adaptation of the 'diene' synthesis to the detection of  $\alpha$ -phellandrene in small quantities, and its estimation in the presence of *p*-cymene, cineol, limonene or  $\alpha$ -pinene.

### Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (NOTTINGHAM MEETING).

Wednesday, September 1

At 8.30 p.m.—Sir Edward Poulton, F.R.S.: "The History of Evolutionary Thought, as recorded in the Meetings of the British Association" (Presidential Address in the Albert Hall).

Thursday, September 2

At 10 a.m.—Sir William Bragg, O.M., K.B.E., Pres. R.S., Dr. G. Shearer, Dr. J. D. Bernal, F.R.S., J. T. Randall and H. P. Rooksby, Dr. A. J. Bradley, and R. M. Powell and W. A. Wood: "X-Ray Methods and Industry" (Symposium: Section A).

Dr. F. L. Pyman, F.R.S., Prof. H. Horlein, Sir Gilbert Morgan, Dr. W. Kikuth and Prof. R. Robinson, F.R.S.: "Some Aspects of Chemotherapy" (Symposium, including Dr. Pyman's Presidential Address entitled "Researches in Chemotherapy": Section B).

Prof. F. A. E. Crew: "The Sex-Ratio" (Presidential Address: Section D).

H. Wolfe, C.B., C.B.E., H. M. Hallsworth, C.B.E. Dr. O. A. Oeser and A. D. K. Owen: "Labour Transference" (Discussion: Section F).

Dr. E. P. Poulton: "Heat Production, Nutrition and Growth in Man—Some New Views" (Presidential Address: Section I).

Prof. E. J. Salisbury, F.R.S.: "The Modern Study of Plants in Relation to Education" (Presidential Address: Section K).

H. G. Wells: "The Informative Content of Education" (Presidential Address: Section L).

J. M. Caie: "State Intervention in Agriculture" (Presidential Address: Section M).

Sir Alexander Gibb, G.B.E., C.B., F.R.S.: "Research in Engineering" (Presidential Address: Section G).

Prof. D. Burns, A. L. Bacharach, Mrs. C. M. Burns, Dr. G. E. Friend, Prof. E. Atzler, Prof. S. J. Cowell: "Contribution of Physiology to the Health of the Individual and the Community" (Discussion: Section I).

At 2.15 p.m.—Prof. J. Ritchie: "The Outlook of Natural Science" (Presidential Address to the Conference of Delegates of Corresponding Societies).

Friday, September 3

At 10 a.m.—Dr. G. W. C. Kaye, O.B.E.: "Noise and the Nation" (Presidential Address: Section A).

Prof. C. R. Harington, F.R.S., Dr. K. Linderström-Lang, Dr. W. T. Astbury, Dr. D. M. Wrinch, Dr. A. Neuberger and J. St. L. Philpot: "Protein Chemistry" (Symposium: Section B).

Prof. L. J. Wills: "Pleistocene History of the West Midlands" (Presidential Address: Section C).

Dame Helen Gwynne-Vaughan, G.B.E., Prof. F. A. E. Crew, Prof. R. A. Fisher, F.R.S., Dr. F. W. Sansome, Dr. C. D. Darlington, Dr. P. C. Koller, E. B. Ford and Dr. J. S. Huxley: "Recent Work in Genetics and Cytology" (Joint Symposium: Sections D and K).

Prof. C. B. Fawcett: "The Changing Distribution of Population" (Presidential Address: Section E).

Prof. P. Sargant Florence: "Economic Research and Industrial Policy" (Presidential Address: Section F). Prof. F. G. Baily and A. P. M. Fleming: "Training of University Graduates for the Engineering Industry" (Discussion: Section G).

Prof. J. H. Hutton, C.I.E.: "Assam Origins in Relation to Oceania" (Presidential Address: Section H).



Dr. Mary Collins: "Tests in Common Use for the Diagnosis of Colour Defect" (Presidential Address: Section J).

Prof. A. M. Carr-Saunders, Sir Frank Fletcher, Mrs. E. V. Parker, M. A. Desclos and Dr. Graefter: "Education for the Community" (Discussion: Section L).

L. Holland, J. Macdonald, J. T. Fitzherbert, Dr. S. E. Wilson, C. J. Jones: "Mining Timber" (Symposium: Section K\*).

Discussion on "Anthropology and Administration" (Section H).

At 7.30 p.m.—Prof. J. Walton: "Coal and its Origin" (Popular Lecture at Mansfield).

At 8 p.m.—R. Kay Gresswell: "Rivers and Waterways" (Public Lecture at Lincoln).

At 8.30 p.m.—Dr. R. E. Slade: "Grass and the National Food Supply" (Evening Discourse).

## Appointments Vacant

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

TECHNICAL OFFICER and ASSISTANTS (grades II and III) at the Air Defence Experimental Establishment, Biggin Hill, Kent (September 1).

ASSISTANTS (grade III—electrical engineering and photographic equipment) at the Royal Aircraft Establishment, South Farnborough, Hants.—The Chief Superintendent (September 3).

RESEARCH ASSISTANT in CHEMISTRY (radioactivity) in the University of Manchester—Prof. M. Polanyi (September 6).

DEMONSTRATOR in HISTOLOGY and EMBRYOLOGY in the Royal Veterinary College and Hospital, Camden Town, London, N.W.1—The Secretary (September 7).

UNIVERSITY ASSISTANT in AGRICULTURAL BOTANY in the University of Aberdeen—The Secretary (September 14).

PROFESSOR OF BOTANY in the University College of the Orange Free State, Bloemfontein—The Rector (September 30).

EXAMINER (Chemist) in the A.I.D. Test House, Kidbrooke (Non-Metallic Material Section, Oils and Petrols Sub-Section)—The Secretary [S.2 (d)] Air Ministry, Kingsway, W.C.2 (October 31).

WATERWORKS ENGINEER for the Government of Nigeria—Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/5346).

LECTURER in GEOLOGY in the University of Rangoon—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, W.C.1.

PROFESSOR OF ANATOMY in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, W.C.1.

## Official Publications Received

### Great Britain and Ireland

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology, No. 10: The Effects of Light and of Oxygen on the Uptake of Sugar by the Foliage Leaf. By E. Phillis and T. G. Mason. Pp. 231-237+2 plates. (London: Empire Cotton Growing Corporation.) 2s. 6d. [48]

Technical College, Bradford. Diploma and Special Day Courses, Session 1937-1938. Pp. 261+21 plates. (Bradford: Technical College.) [48]

British Non-Ferrous Metals Research Association. Research Report, Association Series No. 440: The Fatigue Resistance of Lead and Lead Alloys (Summary Report). By H. Waterhouse. Pp. 8. (London: British Non-Ferrous Metals Research Association.) 2s. [48]

I.C.I. Game Researches. Advisory Leaflet No. 12: Disease; some Simple Treatments. Pp. 10. Advisory Leaflet No. 13: Partridge Stocks and Mortalities. Pp. 10. (London: Imperial Chemical Industries, Ltd.) [58]

Transactions of the Institution of Chemical Engineers. Vol. 14, 1936. Pp. iv+176. (London: Institution of Chemical Engineers.) [68]

The North of Scotland College of Agriculture. Calendar, Session 1937-1938. Pp. viii+128. (Aberdeen: North of Scotland College of Agriculture.) [68]

Department of Scientific and Industrial Research. Forest Products Research Records, No. 19 (Seasoning Series, No. 4): Methods of Kiln Operation. By R. G. Bateson. Pp. ii+13+4 plates. (London: H.M. Stationery Office.) 6d. net. [68]

River Flow Records. By Capt. W. N. McClean. Series A: Rive. Garry. Sheet No. 1. 1s. 6d. Series B: River Moriston. Sheet No. 1. 1s. 6d. Series C: River Ness. Sheets 1-14. In portfolio. 15s. (London: River Flow Records.) [98]

British Trust for Ornithology. Third Report, Summer 1937. Pp. 38. (London: British Trust for Ornithology.) [98]

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1936. Pp. iv+602+10 plates. (London: H.M. Stationery Office.) 15s. net. [98]

Imperial Agricultural Bureaux. Herbage Publication Series, Bulletin No. 19: Production of Grass Seed: an International Exchange of Opinions and Experiences on the Technique of Producing Seed of Gramineous Herbage and Forage Plants. Edited by R. O. Whyte. Pp. 46. 5s. Herbage Publication Series, Bulletin No. 20: Insects and other Pests injurious to the Production of Seed in Herbage and Forage Crops. By H. F. Barnes. Pp. 31+iii. 2s. 6d. Herbage Publication Series, Bulletin No. 21: The Influence of Climatic Conditions on Type Composition. By Nils Sylvén. Pp. 8. 1s. (Aberystwyth: Imperial Bureau of Plant Genetics, Herbage Plants.) [118]

### Other Countries

Department of Public Instruction, Technical Education Branch: New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December 1936. Pp. 6. (Sydney: Government Printer.) [48]

Punjab Irrigation Research Institute. Research Publication, Vol. 2, No. 16: The General Theory of the Gradient of Pressure under a Structure on Permeable Foundations, with Applications to the Evaluation of the Gradient at Exit for some Standard Cases. By Jai K. Malhotra and Dr. E. McKenzie Taylor. Pp. 10. 3 annas; 4d. Research Publication, Vol. 3, No. 2: The Soils of the Rice Areas of the Gujrunwala and Sheikhpura Divisions of the Upper Chenab Canal. By M. L. Mehta. Pp. 25+iii+4 plates. 10 annas; 1s. Research Publication, Vol. 3, No. 3: A Study of the Soil Profiles of the Punjab Plains with reference to their Natural Flora. By R. C. Hoon and M. L. Mehta. Pp. 47+10 plates. 1.3 rupees; 1s. 10d. (Lahore: Punjab Irrigation Research Institute.) [48]

U.S. Department of the Interior: Office of Education. Pamphlet No. 70: Per Capita Costs in City Schools, 1935-36. By Lula Mae Cornstock. Pp. 24. 10 cents. Pamphlet No. 73: Subject Registrations in Private High Schools and Academies, 1932-33. Text by Carl A. Jessen; Statistical Tables by Lester B. Herlihy and Mrs. Blanche K. Choate. Pp. 30. 10 cents. (Washington, D.C.: Government Printing Office.) [48]

Field Museum of Natural History. Botanical Series, Vol. 9, No. 3: Useful Plants and Drugs of Iran and Iraq. By David Hooper, with Notes by Henry Field. (Publication 387.) Pp. 69-242. 1.50 dollars. Botanical Series, Vol. 17, No. 1: The North American Species of Rumex. By K. H. Rechinger, Jr. (Publication 386.) Pp. 152. 1.50 dollars. (Chicago: Field Museum of Natural History.) [48]

Proceedings of the United States National Museum. Vol. 84, No. 3020: Synopsis of the Puerto Rican Beetles of the Genus Mordellistena, with Descriptions of New Species. By Eugene Ray. Pp. 389-400. (Washington, D.C.: Government Printing Office.) [48]

Smithsonian Miscellaneous Collections. Vol. 91, No. 27: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. A New Species of Deep-Sea Fish, *Argyropoleus antrosospinus*, of the Family Sternoptichidae. By Leonard G. Schultz. (Publication 3439.) Pp. ii+6. Vol. 96, No. 3: Phototropic Response and CO<sub>2</sub> Assimilation of Plants in Polarized Light. By Earl S. Johnston. (Publication 3440.) Pp. ii+8. (Washington, D.C.: Government Printing Office.) [48]

Carnegie Institution of Washington. Publication No. 480: Delta, Estuary and Lower Portion of the Channel of the Colorado River 1933 to 1935. By Godfrey Sykes. Pp. vi+70+6 plates. (Washington, D.C.: Government Printing Office.) 1.25 dollars. [58]

International Institute of Agriculture. Studies of the Principal Agricultural Products on the World Market, No. 1: World Cotton Production and Trade. Pp. xii+462+20 plates. (Rome: International Institute of Agriculture.) 30 lire. [68]

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 20, Memoir No. 6: The Mesozoic Brachiopoda of the Attock District. By Dr. Helen M. Muir-Wood. Pp. iv+34+1 plate. (Calcutta: Geological Survey of India.) 2.2 rupees; 4s. [98]

Pasteur Institute of India, Kasauli. The Thirty-fifth Annual Report of the Director of the Institute for the Year 1935, Part 2. Pp. 49. (Kasauli: Pasteur Institute of India.) [98]

Annual Report of the Imperial Council of Agricultural Research for 1936-1937. Pp. v+119. (Delhi: Manager of Publications.) 1.2 rupees; 2s. [98]

Annual Report on Forest Administration in Malaya, including Brunei, for the Year 1936. By J. P. Mead. Pp. iii+66+5 plates. (Kuala Lumpur: Government Printer.) 1 dollar; 2s. 4d. [98]

Indian Forest Records (New Series). Vol. 1, No. 5: Second Interim Report on Work under Project 8 (Testing of Indian Timbers for Veneer and Plywood). By W. Nagle. Pp. iv+115-141. 14 annas; 1s. 6d. Vol. 3, No. 1: Entomological Investigations on the Spike Disease of Sandal (31) Dermoptera and Orthoptera. By Dr. L. Chopard and N. C. Chatterjee. Pp. ii+30. 1 rupee; 1s. 9d. Vol. 3, No. 2: Immature Stages of Indian Coleoptera (21) Cleridae. By J. C. M. Gardner. Pp. 31-47+2 plates. 12 annas; 1s. 3d. (Delhi: Manager of Publications.) [98]

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 8: Malayan Agricultural Statistics, 1936. By D. H. Grist. Pp. xii+91 tables. 50 cents. General Series, No. 26: Reports of the Research, Economic and Agricultural Education Branches for the Year 1936. Pp. iii+97. 50 cents. (Kuala Lumpur: Department of Agriculture.) [98]

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Agricultural and Chemical Series, Bulletin No. 51: Soil and Plant Material Analyses by Rapid Chemical Methods, II. By Francis E. Hance. Pp. 135-186. (Honolulu: Hawaiian Sugar Planters' Association.) [108]

Field Museum of Natural History. Botany Leaflet 21: Tea. By Lewelyn Williams. Pp. 30. (Chicago: Field Museum of Natural History.) 25 cents. [108]



## Recent Scientific and Technical Books

Volumes marked with an asterisk (\*) have been received at "NATURE" Office

## Mathematics : Mechanics : Physics

**Ballard, P. B., and Hamilton, E. R.** Fundamental Geometry. Imp. 16mo. Second Series, Teacher's Book 1. Pp. 66. 2s. 3d. Second Series, Teacher's Book 2. Pp. 63. 2s. 3d. Second Series, Teacher's Book 3. Pp. 81. 2s. 6d. (London: University of London Press, Ltd., 1937.)

**Bentley, W. H. E., and Potts, E. W. Maynard.** Geometry, Part 1: Discovery by Drawing and Measurement. Cr. 8vo. Pp. 112. (London: Ginn and Co., Ltd., 1937.) 1s. 9d.

**Borchardt, W. G.** A School Certificate Mechanics and Hydrostatics. Cr. 8vo. Pp. xii + 391 + xxxiv. (London: Rivingtons, 1937.) 4s. 6d.

**Bragg, W. L.** Atomic Structure of Minerals. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University.) Med. 8vo. Pp. xiii + 292. (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1937.) 18s. net.\*

**Briegleb, G.** Zwischenmolekulare Kräfte und Molekülstruktur. (Sammlung chemische und chemisch-technische Vorträge, Neue Folge, Heft 37.) Roy. 8vo. Pp. 308. (Stuttgart: Ferdinand Enke, 1937.) 22 gold marks.

**Brillouin, Jacques.** Acoustique du bâtiment. 1: L'Acoustique et la construction. i. Bases de la technique à l'usage des architectes, décorateurs, entrepreneurs, etc. (Actualités scientifiques et industrielles, 457.) Roy. 8vo. Pp. 83. (Paris: Hermann et Cie, 1937.) 18 francs.\*

**Brunschvicq, Léon.** Le progrès de l'esprit. 1: La physique du vingtième siècle et la philosophie. (Actualités scientifiques et industrielles, 445.) Roy. 8vo. Pp. 31. (Paris: Hermann et Cie, 1936.) 10 francs.\*

**Cramér, Harald.** Random Variables and Probability Distributions. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 36.) Demy 8vo. Pp. viii + 121. (Cambridge: At the University Press, 1937.) 6s. 6d. net.\*

**Dollon, J.** Problèmes d'agrégation (Mathématiques spéciales). Roy. 8vo. Pp. 211. (Paris: Libr. Vuibert, 1937.) 40 francs.

**Durell, Clement V.** School Certificate Algebra. An alternative version of "A New Algebra for Schools". Cr. 8vo. Pp. xv + 399 + xxxii + xliii. (London: G. Bell and Sons, Ltd., 1937.) 5s.

**Eldridge, John A.** College Physics. Demy 8vo. Pp. x + 616. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 18s. 6d. net.\*

**Epstein, Paul S.** Text-Book of Thermodynamics. Med. 8vo. Pp. 406. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 17s. 6d. net.

**Forsythe, W. E.,** Edited by. Measurement of Radiant Energy. Contributors: Charles G. Abbot, Elliot Q. Adams, Loyal B. Aldrich, Ernest F. Barker, Bentley T. Barnes, William W. Coblenz, Paul H. Dike, Gustave Fassin, William E. Forsythe, Kasson S. Gibson, George R. Harrison, Herbert E. Ives, Loyd A. Jones, Lewis R. Koller, Henry F. Kurtz, A. Herman Pfund, Bartholomew J. Spence, Donald C. Stockbarger, A. Hadley Taylor, Willibald Weniger, Archie G. Worthing. Prepared under the direction of A. C. Hardy, Herbert E. Ives and W. E. Forsythe. Med. 8vo. Pp. xiv + 452. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 30s.\*

**Frank, Philipp.** La fin de la physique mécaniste. Traduction de Jean Lienard. Revue et mise à jour par l'auteur. (Actualités scientifiques et industrielles, 414.) Roy. 8vo. Pp. 57. (Paris: Hermann et Cie, 1936.) 10 francs.\*

**Fréchet, Maurice.** Généralités sur les probabilités; variables aléatoires. (Traité du calcul des probabilités et des ses applications, par Émile Borel, Tome 1: Les

principes de la théorie des probabilités, Fascicule 3: Recherches théoriques modernes sur la théorie des probabilités, Livre 1.) Roy. 8vo. Pp. xvi + 308. (Paris: Gauthier-Villars, 1937.) 90 francs.\*

**Godfrey, C. Woide, and Tair, R. C. B.** Introductory Geometry. Cr. 8vo. Pp. 88. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1937.) 1s. 6d.

**Green, S. L.** Hydro- and Aero-Dynamics: a Theoretical Textbook for Advanced Students of Aeronautics, Hydraulics, Physics and Mathematics. Demy 8vo. Pp. viii + 166. (London: Sir Isaac Pitman and Sons, Ltd., 1937.) 12s. 6d. net.

**Groos, Otto.** Einführung in Theorie und Technik der Dezimeterwellen. Teil 1: Die Schwingungserzeugung und ihre Beeinflussung. (Physik und Technik der Gegenwart, Abteilung Fernmeldetechnik, herausgegeben von Heinrich Fassbender, Band 1.) Med. 8vo. Pp. x + 188. (Leipzig: S. Hirzel, 1937.) 8 gold marks.\*

**Hays, Samuel.** An Outline of Statistics. Ex. Cr. 8vo. Pp. vi + 215. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 6s. net.

**Hellmann, Hans.** Einführung in die Quantentheorie. Sup. Roy. 8vo. Pp. vii + 350. (Leipzig und Wien: Franz Deuticke, 1937.) 20 gold marks.\*

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**l'Institut Henri Poincaré, Annales de.** Vol. 6, Fascicules 3-4: Les lois de probabilité pour les fonctions statistiques, par R. de Misès; Le neutrino, par R. de L. Kronig. Imp. 8vo. Pp. 185-249. (Paris: Institut Henri Poincaré; Les Presses universitaires de France, 1936.) 50 francs.\*

**Jarry-Guérout, Robert.** Dynamique sociale. 1: Les rapports limites de l'ordre et du libre arbitre dans l'évolution des sociétés humaines. 1: Figuration cartésienne du fait social. (Actualités scientifiques et industrielles, 430.) Roy. 8vo. Pp. 66 + 2 plates. (Paris: Hermann et Cie, 1936.) 15 francs.\*

**Johns, R. V., Ware, W. F., and Rees, A. I.** Graded and Everyday Examples in Physics. Cr. 8vo. Pp. vi + 407. 6s. Part 1: Hydrostatics, Statics and Dynamics. Pp. x + 179. 2s. 6d. Part 2: Heat, Light and Sound. Pp. x + 161-307. 2s. 6d. Part 3: Magnetism and Electricity. Pp. ix + 293-387. 2s. (London: Macmillan and Co., Ltd., 1937.)

**Lacroute, P.** Physique atomique et spectroscopie. 1: Raies d'absorption dans les spectres stellaires. (Actualités scientifiques et industrielles, 473.) Roy. 8vo. Pp. 91. (Paris: Hermann et Cie, 1937.) 20 francs.\*

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**Lemaire, J.** Exercices de géométrie moderne à l'usage des élèves de mathématiques spéciales et des candidats à l'agrégation. Roy. 8vo. Pp. 169. (Paris: Libr. Vuibert, 1937.) 30 francs.

**London, F.** Exposés de physique théorique. 21: Une conception nouvelle de la supra-conductibilité; Conférences faites à l'Institut Poincaré, Paris. (Actualités scientifiques et industrielles, 458.) Roy. 8vo. Pp. 81. (Paris: Hermann et Cie, 1937.) 20 francs.\*

**Moeller, Friedrich.** Versuche zur elektrischen Resonanz mit hochfrequenten und niederfrequenten Wechselströmen (Versuche mit kleinen Röhrengeneratoren) mit einer kurzen theoretischen Erläuterung zur elektrischen Resonanz. (Abhandlungen zur Didaktik und Philosophie der Naturwissenschaft, Heft 16.) Imp. 8vo. Pp. v + 82. (Berlin: Julius Springer, 1937.) 4.80 gold marks.\*



**Nightingale, E.** Elementary Physics. Cr. 8vo. Pp. vii + 264. (London: G. Bell and Sons, Ltd., 1937.) 3s. 6d.

**Nightingale, E.** Light. (Heat, Light and Sound, Part 2.) Alternative edition, using New Sign Convention. Cr. 8vo. Pp. viii + 153-272 + iii. (London: G. Bell and Sons, Ltd., 1937.) 2s. 6d.

**Noakes, G. R.** A Text-Book of Light. Ex. Cr. 8vo. Pp. viii + 355. (London: Macmillan and Co., Ltd., 1937.) 6s.\*

**O'Brien, Morrourh P., and Hickox, George H.** Applied Fluid Mechanics. Med. 8vo. Pp. xiii + 360. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 21s.\*

**Palmer, Claude Irwin, and Miser, Wilson Lee.** College Algebra. Cr. 8vo. Pp. xvi + 467. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 15s.

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**Rowley, Frank B., and Algren, Axel B.** Thermal Conductivity of Building Materials. 8vo. Pp. 134. (Minneapolis, Minn.: University of Minnesota Press; London: Oxford University Press, 1937.) 7s. net.

**Shorthose, D. N.** Properties of Matter. Revised edition. Demy 8vo. Pp. viii + 168. (London: William Heinemann, Ltd., 1937.) 4s.\*

**Simmons, Harvey Alexander, and Gore, Grenville D.** Plane Trigonometry: with Five-Place Tables. Demy 8vo. Pp. viii + 201 + 81. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 10s. net.\*

**Stern, Erich.** Nouvelle méthode pour construire et dénombrer certain carrés magiques d'ordre 4m avec application aux parcours magiques. Traduit de l'allemand par le Général E. Cazalas. Roy. 8vo. Pp. 20. (Bruxelles: Librairie du "Sphinx", 1937.)\*

**Uller, Karl.** Die Entdeckung des Wellen-Begriffes. Med. 8vo. Pp. viii + 107. (Würzburg-Aumühle: Konrad Tritsch, 1937.) 5.80 gold marks.\*

**University of Pittsburgh, Members of the Physics Staff of the.** An Outline of Atomic Physics. By Oswald H. Blackwood, Elmer Hutchisson, Thomas H. Osgood, Arthur E. Ruark, Wilfred N. St. Peter, George A. Scott, Archie G. Worthing. Second edition. Med. 8vo. Pp. ix + 414. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 18s. 6d. net.\*

### Engineering

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**Russell, Peter, and Dowell, George.** Competitive Design of Steel Structures. Second impression. Med. 8vo. Pp. xxii + 426. (London: Chapman and Hall, Ltd., 1937.) 21s. net.

**Smith, H. P.** Structural Steelwork for Buildings (Modern Handbooks.) Cr. 8vo. Pp. viii + 104. (London: Crosby Lockwood and Son, Ltd., 1937.) 2s. 6d. net.

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**Timoshenko, S., and Young, D. H.** Engineering Mechanics: Statics. Med. 8vo. Pp. xiv + 334. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 15s.\*

**Weickert, Fr.** Hochspannungsanlagen. (Bibliothek der gesamten Technik, Band 302.) Dritte vollständig neubearbeitete und erweiterte Auflage. 8vo. Pp. 341. (Leipzig: Max Jänecke, 1937.) 10.80 gold marks.

**Wilson, J. C.** Television Engineering. Demy 8vo. Pp. 508. (London: Sir Isaac Pitman and Sons, Ltd., 1937.) 30s. net.

**World Power Conference.** The Transactions of the Chemical Engineering Congress of the World Power Conference, London, June 22-June 27, 1936. Roy. 8vo. Vol. 1. Pp. lxxxv + 525. Vol. 2. Pp. vi + 664. Vol. 3. Pp. vi + 797. Vol. 4. Pp. vi + 751. Vol. 5: Index. Pp. v + 164. (London: Percy Lund, Humphries and Co., Ltd., 1937.) 5 vols., £12.\*

**Young, J. McHardy.** Reinforced Concrete. (Modern Handbooks.) Cr. 8vo. Pp. viii + 86. (London: Crosby Lockwood and Son, Ltd., 1937.) 2s. 6d. net.

### Chemistry: Chemical Industry

**Alexander, Jerome.** Colloid Chemistry: Principles and Applications. Fourth edition. Med. 8vo. Pp. xviii + 505. (London: Chapman and Hall, Ltd., 1937.) 22s. net.\*

**Auld, S. J. M., and Edwardes-Ker, D. R.** Practical Agricultural Chemistry. Cheap edition. Cr. 8vo. Pp. xxiv + 246. (London: John Murray, 1937.) 5s. net.\*

**Bailey, Kenneth C.** The Retardation of Chemical Reactions. Roy. 8vo. Pp. viii + 479. (London: Edward Arnold and Co., 1937.) 26s. net.\*

**Buzágh, A. von.** Colloid Systems: a Survey of the Phenomena of Modern Colloid Physics and Chemistry. Translated by Otto B. Darbishire. Edited by William Clayton. Roy. 8vo. Pp. xix + 311. (London: The Technical Press, Ltd., 1937.) 30s. net.\*

**Cumming, William M.; Hopper, I. Vance, and Wheeler, T. Sherlock.** Systematic Organic Chemistry: Modern Methods of Preparation and Estimation. Third edition, revised by William M. Cumming and I. Vance Hopper. Med. 8vo. Pp. xxvi + 548. (London: Constable and Co., Ltd., 1937.) 25s. net.\*

**Duclaux, J.** Leçons de chimie physique appliquée à la biologie. 8: Pression osmotique. 1: Partie expérimentale. (Traité de chimie physique, Tome 2, Chapitre 3 (Actualités scientifiques et industrielles, 443.)) Roy. 8vo. Pp. 65. (Paris: Hermann et Cie, 1936.) 18 francs.\*

**Fairbrother, F.** Simple Chemistry. Cr. 8vo. Pp. vii + 231. (London: G. Bell and Sons, Ltd., 1937.) 3s.



**Gmelins Handbuch der anorganischen Chemie.** Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 35: Aluminium. Teil A, Lieferung 5: Legierungen von Aluminium mit Zink bis Uran. Sup. Roy. 8vo. Pp. 683-886 +xvi. (Berlin: Verlag Chemie, G.m.b.H., 1937.) 24.75 gold marks.\*

**Grützner, A.** Magnesium-Legierungen: Patentsammlung. Unter Mitarbeit von G. Apel und C. Götze. Zugleich Anhang zu Magnesium Teil A in Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Sup. Roy. 8vo. Pp. vii+192. (Berlin: Verlag Chemie, G.m.b.H., 1937.) 15 gold marks.\*

**Hering, H.** Hautes températures. 1: Dissociation de l'eau en H<sup>2</sup> et OH. (Actualités scientifiques et industrielles, 438.) Roy. 8vo. Pp. 25. (Paris: Hermann et Cie., 1936.) 10 francs.\*

**International Society of Leather Trades' Chemists.** Wetting and Detergency: Scientific and Technical Aspects. Being the Papers presented at a Symposium held in London, February 19-20, 1937, under the auspices of the British Section of the International Society of Leather Trades' Chemists. Pp. 207. (London: A. Harvey; New York: Chemical Publishing Co., 1937.) 15s. net.

**Letort, Maurice.** Exposés de physique moléculaire. 11: Les conceptions actuelles du mécanisme des réactions chimiques (cinétique chimique). Première partie: Généralités, processus élémentaires. Roy. 8vo. Pp. 58. 15 francs. 12: Les conceptions actuelles du mécanisme des réactions chimiques (cinétique chimique). Deuxième partie: Analyse de la réaction globale, conclusions. Roy. 8vo. Pp. 54. 15 francs. (Actualités scientifiques et industrielles, 509, 510.) (Paris: Hermann et Cie., 1937.)\*

**Norman, A. G.** The Biochemistry of Cellulose, the Polyuronides, Lignin, etc. Roy. 8vo. Pp. ix+232. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 15s. net.\*

**Prettre, Marcel.** Exposés de chimie générale et minérale. 10: Réactions en chaînes. Seconde partie: Étude cinétique de diverses réactions de combustion. (Actualités scientifiques et industrielles, 428.) Roy. 8vo. Pp. 79. (Paris: Hermann et Cie., 1936.) 20 francs.\*

**Rosin, Joseph.** Reagent Chemicals and Standards: with Methods of Assaying and Testing them; also the Preparation and Standardization of Volumetric Solutions and Extensive Tables of Equivalents. Med. 8vo. Pp. x+530. (London: Chapman and Hall, Ltd., 1937.) 30s. net.\*

**Schoeller, W. R.** The Analytical Chemistry of Tantalum and Niobium: the Analysis of their Minerals and the Application of Tannin in Gravimetric Analysis. Based upon Original Researches. (Published under the auspices of the Society of Public Analysts and other Analytical Chemists.) Demy 8vo. Pp. xvi+198. (London: Chapman and Hall, Ltd., 1937.) 21s. net.\*

**Schoen, M.** Exposés de chimie biologique. 4: Problèmes d'asymétrie dans les processus biochimiques. (Actualités scientifiques et industrielles, 444.) Roy. 8vo. Pp. 104. (Paris: Hermann et Cie., 1936.) 20 francs.\*

**Science Museum: Board of Education.** Handbook of the Collections illustrating Pure Chemistry. By A. Barclay. Part 2: Descriptive Catalogue. Roy. 8vo. Pp. 84+14 plates. (London: H.M. Stationery Office, 1937.) 2s. net.\*

**Taylor, Hugh S., and Taylor, H. Austin.** Elementary Physical Chemistry. Second edition. Demy 8vo. Pp. xiv+664. (London: Macmillan and Co., Ltd., 1937.) 16s. net.\*

**Valkó, Emmerich.** Kolloidchemische Grundlagen der Textilveredlung. Roy. 8vo. Pp. xi+701. (Berlin: Julius Springer, 1937.) 60 gold marks.\*

**Walden, Paul,** Herausgegeben von. Handbuch der allgemeinen Chemie. Band 9: Hydroxyde und Oxyhydrate. Von R. Fricke und G. F. Hüttig. Unter Mitwirkung von H. Zocher und H. Saechtling. Sup. Roy. 8vo. Pp. xx+641. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 60 gold marks.\*

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**Collins, A. Frederick.** Amateur Power Working Tools. (Woodworker Series.) Cr. 8vo. Pp. 188. (Philadelphia and London: J. B. Lippincott Co., 1937.) 7s. 6d. net.

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