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Science and Politics in India : a Contrast

FROM year to year the Indian Science Congress, like the annual gatherings of the British Association, presents to the public both in and outside scientific circles a survey of recent contributions, chiefly by its own nationals, to the general stream of progress in scientific research and intellectual development. How far this is borne out by the proceedings of the recent Congress held at Hyderabad may be judged, in part, from the summaries of the presidential address and of the addresses of the sectional presidents which appear in another part of this issue of *NATURE* (see p. 638).

It is the privilege, as well as the responsibility, of certain of the sciences that they should bear more directly than others upon human well-being ; and while it may be admitted that a too narrow concentration upon an immediately practical issue cannot but be harmful in the long run, in world conditions as they have now existed for some few years past, the activities of men of science have tended more and more to be submitted to the touchstone of their contact with current realities. Without in any degree abrogating the supremacy of the pursuit of knowledge for its own sake, it is more insistently and more constantly demanded that, as science in its origin arose out of practice, so as a return for the place now conceded it in the organization of modern life, it should contribute guidance in the diagnosis and solution of the problems of society.

Obvious as these reflections may seem, when applied to the conditions of European society, on turning to the consideration of conditions in India, they convey a warning and a moral. In contrasting, as is inevitable, the academic atmosphere of the Science Congress with that of the political arena,

it is difficult to feel that the advantage in grasp of reality does not lie with the former.

The inauguration of the constitution followed on popular elections of a magnitude unprecedented, which gave a majority in six out of the eleven autonomous provinces, into which British India is now divided, to the Congress party. This sweeping victory, for it is nothing less, has been attributed to organization. This party alone, working on lines somewhat similar to those of a British election, was able to put directly before the rural elector the policy of reform and social amelioration which it proposed to pursue. When, however, the victorious party was brought to the practical test, it would seem, in the eyes of most reasonable individuals, to have proceeded to stultify itself by refusing to accept office in those provinces in which the electoral results had laid that responsibility upon it. The patent division of opinion on the wisdom of the course followed as between the leaders of the party and the general body of the Indian Congress, whatever attempts may be made to obliterate it later, gives to the whole situation an air of unreality, which unfortunately tends to confirm the view that with many, though not perhaps with all, the policy of agrarian reform, which has been so widely paraded, is no more than a pawn in the game.

The need for reform in India, and more especially agrarian reform, is so great and so insistent, that eventually, when once the elector has grasped the relation of his vote to political power and social reform, that power will be placed continuously and consistently in the hands of those who are able to give a practical demonstration of their grasp of what has been termed here the realities of the

situation. At present, it is anticipated that Congress will attempt to throw upon the Government the onus of its failure to carry out its policy of social amelioration. In the recent election, many of the voters, it is stated, have suffered from the delusion that in voting for Congress they cast their vote against the Government. As was once said on another continent, "You cannot fool all the people all the time". The sincerity of Congress will be put to a severe test, if and when measures of reform are put forward by the coalition Governments set up in those six provinces where the Congress party is in the majority, and must needs vote for or against such measures of reform.

In the atmosphere of intrigue and legalistic argument which has followed the appointed day, it is something of a relief to turn once more to the findings of science and to enter upon the realm of fact. A rapid glance through the reports of the Indian Science Congress addresses now available will show how far the various branches of science, as studied in India and represented in these addresses, for the most part in the nature of general surveys, are alive to the vital problems of the population, of which the speakers themselves form part. It is indeed the vastness of this population which makes it essential that scientific methods of study should be applied to its problems. It has been pointed out on many occasions that even the functions of Government in India, now in the hands of the natives of India themselves,

cannot be carried out efficiently without the knowledge of the varied racial and cultural discriminations revealed by anthropological studies.

To some extent provision for this has been made by the reservation of areas mainly inhabited by aboriginal or jungle tribes for the administration of the Governor; but the knowledge which must temper administration of the jungle tribes, must equally inform the whole of agrarian reform. No form of life is so impatient of change, so conservative, as the agricultural; and as Dr. Venkatraman pointed out in his presidential address, which deserves the careful attention of all who are interested in the future of India, there are few individuals throughout the whole of that sub-continent who are not affected more or less directly by the life and well-being of the Indian village. How vital the effect of the condition of the Indian village and the village agriculturist may be on the future of this great country is foreshadowed by the president of the Agricultural Section, when he points out that India at present produces two thirds only of the food-stuffs it requires. It is perhaps no rash prophecy to suggest that the future of India rests not with the party which shows itself most adroit and subtle in manipulating the political machine, but with that body of opinion which is most ready to accept the findings of science and to adapt them to the needs of the people in the amelioration of social and material conditions.

Air Raid Precautions

The Protection of the Public from Aerial Attack a Critical Examination of the Recommendations put forward by the Air Raid Precautions Department of the Home Office. By the Cambridge Scientists' Anti-War Group. Pp. 127. (London: Victor Gollancz, Ltd., 1937.) 2s. 6d. net.

IN this book, the authors—a group of anti-war scientists at Cambridge—have published a slashing attack on the recommendations put forward by the Air Raid Precautions Department of the Home Office for the protection of the public, and they offer scientific evidence to show that these measures are entirely inadequate.

The chief criticisms made in the book are as follows:

(1) 'Gas-proof' rooms prepared according to the instructions given in the Air Raid Precautions

handbooks are not gas-tight; and the results of the tests that were made by the authors show that, assuming the air outside contains enough mustard gas to kill a man in an hour, it would penetrate such rooms in sufficient concentration to kill him in three hours. Besides, millions of people live in such conditions that they are unable to set aside a room as a gas shelter.

(2) A privately manufactured gas mask costing 17s. 6d. (not the type which the Government proposes to issue) was tested, and although it was found to be fairly satisfactory, the complaint is made that no mask can give complete protection against mustard gas because the latter affects the whole surface of the body.

(3) Incendiary bombs would be used in such numbers that the present fire brigade system would be inadequate to deal with the resulting fires.

(4) No protection for children under five years of age has yet been proposed.

Some of these criticisms seem to have been premature, for immediately after the publication of the book the Government announced its intention of organizing a fire-fighting force of 200,000 men, as well as auxiliary fire stations; and it also stated that a number of possibilities for the protection of young children against gas were being examined.

It is not clear why a privately manufactured gas mask was put through tests: this can scarcely have been in order to prove the ineffectiveness of the Government pattern; and to point out that no mask can give protection to the whole surface of the body from mustard gas vapour was surely unnecessary. No one, of course, would expect it to do so, any more than he would expect a bowler hat to keep his feet dry on a wet day. The recommendations made to meet the danger from mustard gas are to keep under cover so as to avoid direct contamination from the liquid sprayed from the air, and to remain in a home shelter, made as gas-proof as the circumstances permit, until the danger is over. What more can be expected? It would, of course, be possible to issue a complete suit of oilskins to every member of the public and to exchange them for clean ones whenever contamination was suspected; but this is a procedure which would not be regarded as reasonable or practicable by ordinary men.

It is true that in many of the poorer homes completely gas-proof shelters can only be provided with great difficulty; but that is no reason why the remainder should not be protected, or why the attempt should not be made to carry out the instructions so far as possible. The degree of protection can be increased in every case, whatever the circumstances, and it is not necessary to 'set aside' a room for the purpose, as anyone can see for himself by visiting the specimen gas-proof room at No. 17 Aldermanbury, E.C.

However, it is the results of the authors' experiments on the gas-proof rooms which I think will cause chief surprise and public interest. In the tests made, four rooms were 'sealed' in the manner recommended by the Home Office, and carbon dioxide gas was released in quantities calculated to produce concentrations of 5 per cent in each one; and it was found by measurement that half the gas had leaked out in $2\frac{1}{2}$, $2\frac{1}{2}$, $3\frac{1}{2}$ and $9\frac{1}{4}$ hours respectively. The authors conclude, but not by direct experiment with the same gas, that leakages into the room from outside would take place at the same rate, and that it occurs in little streams of air blowing to and fro in the small holes and tiny cracks in the plaster, bricks, doors, etc.

Theoretically, of course, gas can penetrate almost any material, but experiments showing the rate of leakage *from the open air into a gas-proof room* would have been of far greater interest to everybody who takes an interest in air raid precautions.

When questioned in the House of Commons about these remarkable results, the Government spokesman, after consulting his own scientific advisers, stated that the experiments themselves depended on academic assumptions, and that the deductions made from them had been interpreted on purely theoretical lines and had been proved to be open to grave criticisms. He went on to say that the experiments on which the Government recommendations were based had been conducted with actual war gases liberated under practical conditions, and with particular regard to the circumstances in which gas can be discharged from aircraft, and the measures proposed would be effective in affording a very great measure of protection to the public. He might have added that his own scientific advisers were the same men who had carried out thousands of experiments with poison gases during the Great War and had been engaged on chemical defence problems ever since. I have no connexion whatever with the Air Raid Precautions Department of the Home Office and am not concerned in its defence; but I am being consulted by numbers of business concerns who desire to organize their air raid precautions on the lines recommended by the Home Office: I believe that the recommendations are generally sound and reasonable, and it is important that public confidence in these measures shall not be shaken unnecessarily.

Many readers of NATURE will recollect the steps that were taken during the Great War to safeguard the shelters in the forward areas against gas: gas attacks were a daily experience, especially during the later stages of the War, and every shelter and dugout in the forward area was 'gas-proofed' precisely in the manner recommended by the Home Office—that is, by stopping cracks, hanging up curtains, providing 'air locks', and so on; and these measures were proved to be so effective in actual practice by all the armies engaged that in planning gas attacks with shells, clouds from cylinders, or projector and trench mortar bombs, no attempt was made to employ tactics designed to penetrate the protection thus afforded. (The group of Cambridge scientists would perhaps suggest that a still greater degree of safety could have been obtained by stopping the war altogether.) The victims of gas attacks were for the most part men who were caught unawares, or were compelled by the nature of their duties to remain out in the open; and this

would also be the experience of civil populations subjected to aerial gas bombardment. Some of our dense gas clouds penetrated far behind the German front line, but because of the precautions adopted we never heard of civilians suffering serious inconvenience on account of them. For example, vegetation in the gardens of Lille was often bleached by our gas, but the inhabitants were warned of its approach by the ringing of bells, and they took refuge in the top rooms of their houses and closed all the windows and doors. Nor did these gas attacks cause them sufficient discomfort to create resentment: the wife of the mayor of one of these towns, after its reoccupation by the British army, told us that she had always had German officers billeted on her and that they feared gas more than anything else: "Give them gas all the time," she said, "and then more gas."

The authors of this book in their destructive criticism seem to ignore the fact that some degree of protection is better than none, and their conclusions would carry greater conviction to the ordinary man in the street but for the suspicion that scientific theories may sometimes be perverted for political ends.

As one who has had, perhaps, more experience of the stark realities of gas warfare than anyone else, and has studied the reports of thousands of field tests carried out by British, French and American gas experimenters as well as witnessed many of the tests personally, I do not believe that anything approaching a concentration of 5 per cent of gas can be established in the open air by an aerial or any other kind of bombardment. Such a bombardment, to have any appreciable success, would have to be sustained and systematic, and I cannot believe that it could continue for a period of three

hours over, say, London without interference. Anything less would be ineffective except in the most exceptional atmospheric conditions: in comparatively open spaces, such as the neighbourhood of Imperial Chemical House, gas would drift away and be dissipated at a rate varying with the prevailing air currents; while in circumstances most favourable to it, say, in the City, with its tall buildings and narrow courts and lanes, the dispersion of gas clouds by movements of the air would be delayed, but most of the blocks here are well provided with basements and strong-rooms which are shelters within a shelter, so that even if all the windows were shattered, gas in any harmful quantity could be excluded by gas-proofing the staircases and lift shafts and by providing airlocks in the manner recommended. As for gas penetrating brick and concrete walls from the open air outside, this is no doubt theoretically possible, but in my own shelter, provided that the sealing is carefully carried out, I would be content with a good strong wall-paper—let alone the brick wall to which it is attached.

This book can do nothing but harm. It suggests no better defensive measures than those recommended by the Home Office, while it is calculated to destroy confidence in them and to create panic. Nor can it have the slightest effect in stopping war: there is probably no reasonable individual in Great Britain who would be willing to make war at the present moment, except in the case of absolute necessity imposed upon us by the 'mad dogs' of Europe; and if that necessity should arise, let us hope that we will not be deterred from our duty to ourselves and to posterity by contemplating its horrors—still less by exaggerating them.

C. H. FOULKES.

Maps through the Ages

The World in Maps:

a Study in Map Evolution. By Prof. W. W. Jervis. Pp. 208+4 maps. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1936.) 7s. 6d. net.

DESPITE the increasing interest in maps now manifest, no one in Great Britain has yet undertaken a really comprehensive work on all sides of the subject, such as was attempted in Germany some years ago by Max Eckert. The present modest effort makes no pretence of filling the gap, its aim being rather to provide the intelligent layman with a general introduction to

the subject. Apart from the width of the survey, it does not go greatly beyond previous attempts of a popular kind, and it, of course, has no claim to vie with the excellent books on the technical side of map-making now available.

The arrangement of the book shows some lack of system. It begins with chapters on practical matters, such as the indication of scale and direction, projections, topography and relief, with an attempt to trace the evolution of method from early times. Then follow two chapters on the maps and map-makers of medieval and early modern times, while the last part is concerned with requirements and methods of map-production at

the present day, including a chapter on national map departments. The historical side of the subject is kept prominently in view through most of the book, and it is perhaps permissible to deal chiefly with this in the following comments.

The author certainly displays a fairly wide acquaintance with the maps and methods of the past; but he is too often betrayed into statements which show that his knowledge is but superficial, and that he has imperfectly digested what he has taken from other writers. Also he has missed some of the more important authorities on certain points; for example, his perfunctory treatment of the history of the prime meridian takes no account of Mr. W. G. Perrin's excellent summary of the subject. In places he seems to have reproduced the jottings of his note-book with little attempt at arrangement or revision. Thus in Chapter viii there are two inconsistent references, separated by a few pages, to Christopher Saxton's large map of England, one passage having evidently been written before, the other after, the acquisition by the British Museum of a unique early copy. A good many statements are misleading, to say the least, and the following instances are but a few out of many. It is scarcely true that Münster's maps were standard for a century; that Mercator invented the Southern Continent; or that Blome was a publisher "of very high repute". On reading that Moses Pitt's English

Atlas was a "good attempt to rival Dutch Cartography", one would scarcely realize that the actual basis was entirely Dutch. Instances of slipshod language abound. We find *Portolani*, *Reinels* treated as singular, *Mappa Mundi* as plural, and there are many misspellings of names—Duningsby for Dunningley, Wauermann for Wauwermans, Zugler for Ziegler, Philpott for Phillott, and others. The chronological list of maps makes an imposing show, but it contains many errors, including the astonishing statement that the Rome map of the British Isles of 1546 was "made by Speed"—then unborn. Both in this list and the extensive bibliography, better judgment might have been shown in selecting the entries.

The chapters on modern map-making are not perhaps open to such serious criticism, and the views expressed seem generally judicious, as when the advantage of the 'dot' system to represent distributions is stressed. This part may be of use to those desiring a general view of the subject without going deeply into it.

One can only regret that the author should have been so hasty in publishing his notes, for he would no doubt be capable of better things with further study and more care to verify his references. The publishers have added a series of outline sketches of early maps, mostly taken from previous publications of the firm, and not linked to the text by any commentary. E. HEAWOOD.

Probability: Theory and Applications

Elements of Probability

By Prof. H. Levy and L. Roth. Pp. x + 200. (Oxford, Clarendon Press; London: Oxford University Press, 1936). 15s. net.

THIS is an interesting book. Its main interest lies in the endeavour of the authors to keep throughout a clear distinction between three different fields of study, all in some way inter-related and each forming a partial approach to the general problem of probability: (1) a mathematical theory (the authors add, "of arrangements" which I should prefer to omit), (2) the frequency of actual occurrences of an event in repeated trials and (3) the psychological expectation of a participant. The authors are primarily interested in (1), and assume the definition of mathematical probability as follows:

"If there is a group of N letters consisting of n letters a_1 , n_2 letters a_2 , ... and n_r letters a_r , the probability of a letter specified as belonging to the class a_1, a_2, \dots, a_r being a letter a_s is n_s/N ."

In other words, the probability of an object A ,

possessing a property B , is defined as the proportion of those objects A which actually possess the property B .

I am not exactly clear about the opinions of the authors given on pp. 22–23. One way of interpreting them is that it is impossible to build up a mathematical theory of probability both rigorous and useful, starting with some conveniently formulated axioms forming a mathematical model of what is known or assumed about the processes of mind, connected with expectation. If the authors mean to affirm this, I cannot share their opinion.

Practical applications of the theory of probability built up on the above definition require the construction of a mathematical model of the practical situation studied, involving a class of objects subdivided into several sub-classes.

The definition quoted is, of course, not new. It is adopted in many recent publications and is taught in many lecture theatres. But usually it is soon forgotten and the succeeding development

of the theory is carried out in terms of 'experiments', 'frequencies', etc. It is true that such expressions, having no immediate relation to the definition, stand for something else, reducible to this definition. However, the process of reduction is not so easy as one may imagine, and the student is frequently led to a confusion of (1) with (3) or with (2) respectively.

It may be useful to illustrate this point. Suppose that a bag A contains three balls, one with 1 and two with 2 written on them. Besides the bag A there are two more bags, one distinguished by the number 1 and the other by 2. The bag 1 contains five balls, of which one only is black. The bag 2 contains seven balls of which exactly four are black. We perform an experiment consisting in two drawings of balls. First we draw a ball from the bag A , next we draw a ball either from bag 1 or from bag 2, according to what was the number on the ball drawn from A . The question asked is, What is the probability of ultimately drawing a black ball? If this problem were given to an average undergraduate, he would probably immediately produce the correct answer, $47/105$. If he started his studies in probability with a definition similar to that given by the authors, he would agree that this number represents the "proportion of things A having the required property B ". But if the definition in terms of the proportion was not followed by a special training in distinguishing between (1), (2) and (3), he would find difficulty in explaining what exactly are these "things A ", what may be their total number and what is their "property B ". Confronted with these questions, the student would be surprised to discover that he was not clear about the whole problem which seemed to be so simple. It is this surprise, contrasted with the quiet attitude to the obtained result $47/105$, which indicates that in the process of reaching it, the student had in his mind not the definition of probability assumed, but some more or less vague ideas concerning frequencies or psychological expectation: the confusion of (1) with (2) or (3) which the authors try to help to avoid.

The book under review is very valuable because the authors consistently apply the definition quoted so as to accustom the reader to the basic idea involved. They go so far as to reword the usual theorems of summation and multiplication of probabilities, Bernoulli's Theorem, etc., constantly referring to the idea of proportion. However, the usual wording, in terms of experiments, has become customary partly because of its convenience. Therefore, after training the reader for a period, the authors return to the traditional terminology, pointing out that this should be accepted as a convention.

It is difficult to say whether the new wording of usual theorems introduced by the authors is a success. I personally use the definition adopted by the authors, and I recognize the necessity of rewording the theorems, but I use another way of speaking, in terms of "things A " and their "properties B ". Which of the two is more convenient is probably a question of taste, but it may be useful to give an example. The multiplication theorem as given by the authors, reads:

"If P_1 is the probability that an object belongs to the sub-class a_1 of classes a_1, a_2, \dots, a_r , and P_2 is the probability of its belonging to the sub-class A_1 , of the classes A_1, A_2, \dots, A_s (which are exclusive to a_1, a_2, \dots, a_r), then the probability that it belongs to the combined class a_1A_1 , is p_1P_2 ."

It seems to me that the following statement is somewhat simpler:

"The probability, $P\{BC/A\}$, that an object A possesses the two properties B and C is equal to the probability, $P\{B/A\}$, that it possesses the property B , multiplied by the probability $P\{C/AB\}$ that an object A which possesses the property B possesses also the property C ."

Incidentally, this wording makes it easy to introduce the conception of stochastic dependence which is somewhat neglected by the authors.

The original definition, applicable in cases when the set of objects considered is finite, is later extended to cover the case of continuity. The obvious method of extension in terms of the measure of the sets of points has not been adopted by the authors, probably because of the elementary character of the book.

Two long chapters are given to the theory of arrangements. In another two chapters, occupying altogether 100 pages, the authors discuss various problems relating to statistics. One of these, concerning selective sampling (pp. 146-165), seems to deserve special attention of the reader. Throughout the book, there are many interesting examples and illustrations.

I have noticed a few minor lapses. Thus, for example, after having shown accurately that the variance of the binomial is npq , the authors describe (page 142) the expression \sqrt{npq} as the mean value of $|r-np|$, which is, of course, not exact.

In conclusion, I should like to mention a short but very interesting historical introduction, preceding the main part of the book. It brings out how all aspects of probability are historically interlocked in scientific method and social practice, and so presents a united background against which the various partial analyses can be appraised.

J. NEYMAN

Faune de France

30: Cestodes. Par Prof. Ch. Joyeux et Dr. J. G. Baer. (Fédération française des Sociétés de Sciences naturelles: Office central de faunistique.) Pp. iii+613. (Paris: Paul Lechevalier et fils, 1936.) 200 francs.

TAPEWORMS are psychologically nasty animals, but they are relieved by attractive life-histories. The elongated worm with its many segments lives in the gut of vertebrates and breaks off its hind divisions (proglottides), passing them out with the faeces of the host. These are full of ripe eggs which are shed on to the ground or into the water. Then comes along some animal which swallows them. Reaching its stomach, they bore through its wall to rest as rounded bladder worms (cysticerci) in its body, where they may swell up forming cysts of fluid, into which may project one or more heads. They, if eaten by their first host, attach themselves by their heads to its gut wall and bud off segments to form elongated tapeworms, which in turn repeat the life-cycle. Occasionally one host serves for both worm and cysticercus; many have both stages in vertebrates, but probably the majority have their cyst stage in some invertebrate, species being enumerated in jelly-fish, worms, crustaceans, insects and molluscs.

Settled rules as to these and other biological matters will be sought in vain in this catalogue of more than 2,000 species, for the life-histories of many are unknown, and this number probably does not represent half the species found in France. Clearly allied species of vertebrates commonly have the same tapeworms; but this may well be a question of similarity of food, since quite distantly related animals feeding on the same food often have the same worms. We might like to think of the evolution of the worms and of their hosts going on together, but, while encouraged by the unsegmented and presumably primitive *Gyrocotyle* and *Amphilina* being restricted to *Chimaera* and the sturgeon, this does not seem to be the case. *Gyrocotyle*, anyhow, is exceptional, as it is often found in the mud frequented by *Chimaera*.

In any event, this monograph, when studied, suggests all kinds of problems, both physiological and evolutionary, and should be in the reference library of every zoological and medical department. It is illustrated by 569 most useful line illustrations and gives all the necessary data both as to the parasites and their hosts.

Beiträge zur Mineralogie von Japan

Begründet von T. Wada. Neue Folge, 1. Herausgegeben von T. Ito. Pp. vii+xviii+259. (Tokyo: Imperial University, 1935.)

NOR a great deal has been written about the minerals of Japan. The earliest information about them is contained in the treatise written by the late Prof. T. Wada, of which an English translation by T. Ogawa appeared in 1904. A second edition followed, but only in Japanese. Inasmuch as supplements speedily became necessary in order to keep the information

up to date, Prof. Wada began in 1905 a series, under the general title of "Beiträge zur Mineralogie von Japan", which was to consist of original papers on Japanese minerals written in either German or English; the latter language, however, was invariably selected by the contributors. The series came to an end in 1915, and Prof. Wada died in 1920.

The present volume is intended by the author, the director of the Mineralogical Institute of the Imperial University of Tokyo, to be the first of a new series of contributions, which ultimately will be used in the preparation of the third edition of Prof. Wada's treatise. Despite its German title, the text is in Japanese, but there is a good summary in English, and throughout the text ordinary letters and numerals are used to denote the crystal faces, so that the reader need not know Japanese to cull information from the pages. The volume is dedicated to the memory of the late N. Fukuchi, who was lecturer in mineralogy at the Imperial University, and did much work on Japanese minerals; his portrait forms the frontispiece.

The volume comprises seventy-six original contributions, together with an introduction descriptive of the two-circle method of measuring crystals and denoting the positions of their faces. There are two indexes: in Japanese with English equivalent, and vice versa. The summary is provided with its own pagination and index. A map showing the localities mentioned adds greatly to the value of the volume.

Les rites secrets des primitifs de l'Oubangui

Par A.-M. Vergiat. (Bibliothèque scientifique.) Pp. 212+32 plates. (Paris: Libr. Payot, 1936.) 25 francs.

M. VERGIAT, an experienced observer and skilled recorder with the camera of native life and custom in more than one part of Africa, has taken advantage of the opportunity afforded by a botanical excursion to the French Congo to investigate the esoteric beliefs and rites of the tribes of the region. More fortunate than most Europeans who attempt, usually with indifferent success, to penetrate these *arcana*, he won the confidence of a native sorcerer, who accompanied him when he was collecting botanical specimens, and passed on to him much of his knowledge. For this indiscretion, it would seem, the informant paid the penalty with his life. In the meantime, however, the author had not only acquired a detailed knowledge of the religious and spiritual beliefs of the people, but also had secured full particulars of the initiation ceremonies and circumcision rites practised at puberty, as well as of the ceremonial of admission into the principal secret societies. His account of the female ceremony of clitoridectomy, which is illustrated by photographs, is exceptionally full. In recording such matters as these, the author no doubt has good reason for making no explicit statement as to how such valuable detailed information was obtained.

As a botanist, M. Vergiat was much interested in the plants used in native magic and medicine. Of these, he gives detailed lists with identifications.

Pigments Associated with the Fatty Tissues of Plants and Animals*

By Prof. I. M. Heilbron, F.R.S., and A. E. Gillam.

THE fat-soluble pigments (lipochromes) which form the subject of the present survey, comprise a sharply defined class of yellow to violet-red compounds not only widely distributed in flowers and fruits, but also met with throughout the whole of the animal kingdom. In virtue of the fact that the first of these pigments to be obtained in crystalline form was isolated from carrots, they are commonly known as carotenoids. As a group they are characterized further by their insolubility in water, by their sensitivity to atmospheric oxygen, which readily bleaches them, and by the deep blue coloration which they give with sulphuric acid. In addition to its occurrence in the carrot, the most typical member of the group, carotene, is invariably found with chlorophyll in all green foliage, being also associated with another yellow constituent to which the name xanthophyll was originally given. Despite the wide distribution of these two pigments in Nature, it must be emphasized that they, in common with other members of the group, occur only in very minute amounts in living matter. Thus the fresh carrot contains only about 0.1 per cent of carotene, whilst in fresh grass the order approximates only to 0.01 per cent carotene and 0.02 per cent xanthophyll.

Although carotene was originally isolated so early as 1831, the first work of real chemical significance in this field was due to Willstätter and his collaborators who, during the years 1906-14, effected the isolation of several of the more important carotenoids in crystalline form and established their empirical formulæ. It was thus found that carotene was a hydrocarbon having the formula $C_{40}H_{56}$ and that it was isomeric but not identical with lycopene, the pigment of the ripe tomato. Similarly, leaf xanthophyll was shown to have the formula $C_{40}H_{56}O_2$ and to be very similar to, if not identical with, the yellow pigment of egg yolk, then known as lutein. Another interesting member characterized at this period was a still more oxygenated pigment, fucoxanthin, $C_{40}H_{56}O_6$, which was obtained from *Fucus vesiculosus*, a member of the brown seaweeds.

The further development of the chemistry of the carotenoids languished until 1928, when Zechmeister, Chlcnoky and Vrabely proved, by

means of quantitative catalytic hydrogenation, that carotene contains eleven ethenoid linkages giving rise to a saturated perhydrocarotene of formula $C_{56}H_{78}$, from which it can be deduced that the pigment itself must contain two cyclic systems. In a similar manner, Karrer and Widmer ascertained that lycopene absorbs thirteen molecules of hydrogen yielding a paraffin hydrocarbon $C_{40}H_{82}$, a result which shows that the pigment must be acyclic.

The next important development in our knowledge of the carotenoids came about when Kuhn, Lederer and Winterstein reintroduced the method of chromatographic analysis, as a means of separating and purifying the individual pigments of plant tissues. So early as 1906, the Russian botanist Tswett had shown that substances such as calcium carbonate or powdered sucrose, when packed in vertical columns, have the power of absorbing pigments from their solutions in non-polar solvents such as light petroleum, and that with a mixture of pigments the constituents orient themselves as coloured zones or bands at various positions on the column, depending upon the strength of adsorption of the individual components. On applying this technique to ordinary carrot carotene, it was found that the pigment could be separated into two distinct components, the optically inactive β -carotene and the dextrorotatory α -carotene. The former is adsorbed above the latter when the chromatogram is developed by washing with light petroleum. Of these two isomerides, β -carotene generally predominates, although in palm oil carotene there is as much as thirty per cent of the α -isomer.

Shortly after this discovery, the presence of a third isomer, γ -carotene, was disclosed under conditions which serve to emphasize the elegance of this technique, which more than any other has contributed to the recent rapid progress in this field. Commencing with 35 gm. of commercial crystalline carotene (equal to about 6 cwt. of raw carrots) Kuhn and Brockmann subjected it to chromatographic adsorption and observed a small pigmented zone above that of the β -carotene in the column. After many adsorptions they ultimately succeeded in isolating from the collected upper zones 34 mgm. of the γ -isomeride, with which amount they were able to study its physical, chemical and biological properties and so advance a structural formula for the

* Expanded from a Friday evening discourse at the Royal Institution delivered by Prof. I. M. Heilbron on February 12.

compound—a remarkable example of the delicacy of modern chemical technique.

A further interesting and important point in connexion with chromatography is that not only does it provide us with a readily accessible method for the isolation of minute amounts of specific pigments, but it provides in addition a means of differentiating various classes. Thus the hydroxylated carotenoids (or xanthophylls as they are now generally called) are all much more strongly adsorbed than the hydrocarbon pigments; moreover, the degree of adsorbability is proportional to the number of hydroxyl groups.

Another criterion determining the position of adsorption in the column is the number and disposition of unsaturated linkages. This is illustrated by the fact that lycopene, γ -carotene, β -carotene and α -carotene are retained on the adsorption column in descending order, which corresponds partly with the total number of ethylene linkages in their molecules and partly with the length of the conjugated system. This latter effect is evidenced in the β - and α -carotenes, both of which contain eleven double bonds. In the former, however, these are all conjugated, whereas in α -carotene only ten are so arranged. Table I (due to Winterstein) illustrates these general principles:

TABLE I.

RELATIVE ADSORBABILITY OF VARIOUS CAROTENOIDS FROM LIGHT PETROLEUM SOLUTION

Strongest adsorbed	Fucoxanthin	$C_{40}H_{56}O_6$	Alcohols	} $CaCO_3$			
	Violaxanthin	$C_{40}H_{56}O_4$					
	Taraxanthin	$C_{40}H_{56}O_4$					
	Flavoxanthin	$C_{40}H_{56}O_3$					
	Zeaxanthin	$C_{40}H_{56}O_2$	Ketone		} Al_2O_3		
	Lutein	$C_{40}H_{56}O_2$					
	Rhodoxanthin	$C_{40}H_{56}O_2$					
	Physalene	$C_{72}H_{116}O_4$					
	Helenien	$C_{72}H_{116}O_4$	Esters			} Al_2O_3	
	Lycopene	$C_{40}H_{56}$					
	γ -Carotene	$C_{40}H_{56}$	Hydrocarbons				} Al_2O_3
	β -Carotene	$C_{40}H_{56}$					
	α -Carotene	$C_{40}H_{56}$					
	α -Carotene	$C_{40}H_{56}$					
Weakest adsorbed							

The separation by chromatographic methods alone of a complex mixture of pigments such as is often met with in Nature, is an extremely complicated procedure. Fortunately, however, it can frequently be simplified by carrying out a preliminary partition between two immiscible solvents such as light petroleum and 90 per cent methyl alcohol, when it is found that hydrocarbon pigments and esters pass into the petroleum layer (epiphasic pigments), whilst those pigments containing free hydroxyl groups pass preferentially into the alcohol (hypophasic pigments).

Another physical property of great diagnostic value in the study of carotenoids is that of light absorption. It is a well-established principle that with an increasing number of conjugated unsaturated linkages in a molecule, the absorption maxima become progressively displaced towards longer wave-lengths. This is exceptionally well

exemplified among the carotenoids, which are characterized by well-defined triplet absorption bands, and the closest possible correlation exists between the position of the bands and the number and character of the conjugated centres. These effects are shown in Table 2.

TABLE 2

EXAMPLES OF THE EFFECT OF UNSATURATION ON THE ABSORPTION SPECTRA OF TYPICAL CAROTENOIDS

Carotenoid.	Number of Double Bonds.		Absorption maxima in CS_2 ($m\mu$)	
	Conjugated	Unconjugated		
Rhodoxanthin	14(2C=0)	0	564	525
Lycopene	11	2	548	507
γ -Carotene	11	1	533	496
β -Carotene	11	0	518	485
α -Carotene	10	1	508	477
Violaxanthin	9	1	501	469

It is beyond the scope of this article to attempt to describe in detail the elegant investigations of Karrer, Kuhn, Zechmeister and their respective collaborators, which have culminated in the elucidation of the constitution of these pigments. The formulæ for the four hydrocarbon pigments are given on p. 614, and these represent the fundamental structures upon which a large number of naturally occurring oxygenated derivatives are built.

In Table 3 the hydrocarbons and the simpler xanthophylls which correspond to them are enumerated.

TABLE 3

RELATION BETWEEN THE HYDROCARBON CAROTENOIDS AND THE SIMPLER XANTHOPHYLLS

Hydrocarbon	Monohydroxy Derivative	Dihydroxy Derivative
$C_{40}H_{56}$	$C_{40}H_{56}O$	$C_{40}H_{56}O_2$
Lycopene	Lycoxanthin	Lycophyll
γ -Carotene	Rubixanthin	—
β -Carotene	Kryptoxanthin	Zeaxanthin
α -Carotene	—	Lutein

Of the various possible types of oxygenated carotenoids, alcohols are of most frequent occurrence, and of these it will suffice to mention a few of the more common. Leaf xanthophyll, which consists mainly of a pigment having the formula $C_{40}H_{56}O_2$, has been re-named lutein, and is actually a dihydroxy derivative of α -carotene, with which it is spectographically identical. The pigment of egg yolk, originally called lutein, has now been separated into lutein proper (leaf xanthophyll) and an isomeric pigment, zeaxanthin. This is a dihydroxy β -carotene occurring in small quantity in many leaves, berries and fruits, but most readily isolated from maize. The acyclic analogue lycophyll has recently been isolated from several species of *Solanum*. Of other xanthophylls mention may be made of flavoxanthin $C_{40}H_{56}O_3$, the yellow buttercup pigment, violaxanthin $C_{40}H_{56}O_4$, the yellow pansy pigment, and the isomeric taraxanthin from the dandelion.

The pigments so far considered have all been representatives of the higher forms of plant life, but among the Cryptogams, lipochrome pigments also abound, especially among the Algæ. Recent work in this field carried out in the University of Manchester, has brought to light some interesting generalizations. It would seem that whereas carotene is common among all algal orders exactly as in the higher plants, a definite differentiation of

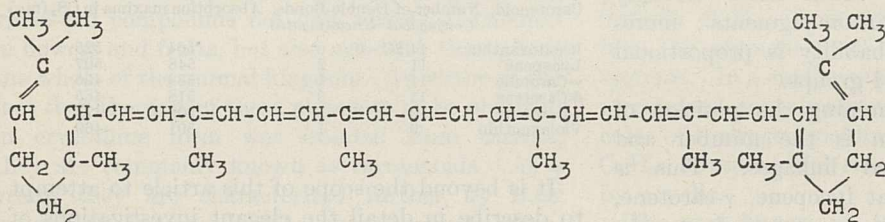
are met with throughout the animal kingdom, from the lowest types of life to man himself. Among the vertebrates, the carotenoids are absorbed from the feed and consist therefore mainly of carotene and lutein. Zechmeister and his co-workers have recently made a close study of this subject, and have shown that certain interesting differences are to be observed among the higher animals; thus although the carotene-

lutein ratio in grass is of the order 1 : 2, both the cow and the horse preferentially absorb carotene to the almost complete exclusion of lutein. Man, on the other hand, evinces no especial preference, and both pigments are found to be present in human blood serum, whilst in the pig, cat, dog and the rodents no carotenoids appear to be retained. The early experiments of Palmer have shown that birds accumulate xanthophylls, to the almost complete exclusion of carotene, in their blood and body-fat as well as in their egg yolk. It has also been shown by Brockmann and Völcker that the yellow colour of the plumage of canaries is due to the presence of lutein, or a closely related transformation product, and is produced solely when this pigment is present in the food, for in its absence the feathers become white.

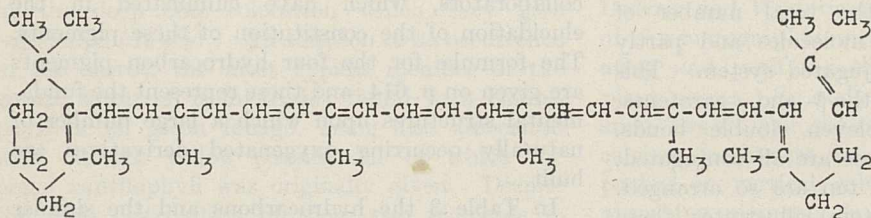
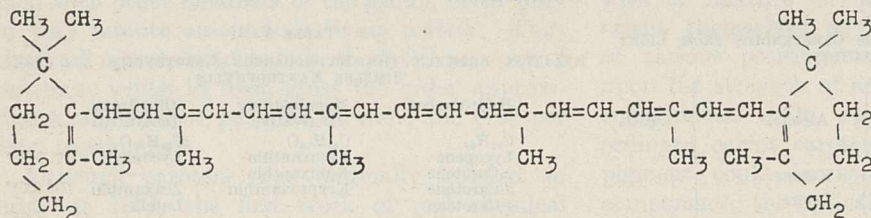
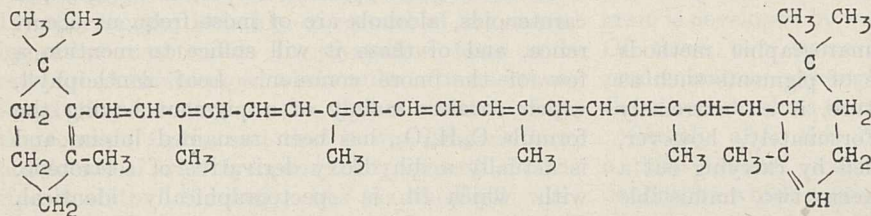
Turning now to the invertebrates, here a great

diversity of carotenoids, distinct from those found in plant tissues, are met with. Among the Crustacea, the characteristic bluish colour of the live lobster is due to the presence of a labile chromoprotein, which breaks down at the temperature of boiling water liberating the free lipochrome, astacene. This pigment, which is a tetra-keto- β -carotene, $C_{40}H_{56}O_4$, is very widely distributed in aquatic animals, being found in the skin of goldfish, in starfish, in the flesh of salmon, etc.

Among other marine forms, the sea anemones



Lycopene

 γ -Carotene β -Carotene α -Carotene

pigment is met with in the various species of Algæ. As examples of this, the Phæophyceæ (brown Algæ) are all characterized by the presence of fucoxanthin, a pigment which is very easily distinguished by the beautiful colour which it gives with 25 per cent hydrochloric acid. Again, among the Cyanophyceæ (blue-green Algæ), a specific pigment, myxoxanthin, is seemingly common to all members of the group.

As already mentioned, the carotenoids are by no means confined to the plant world, but

also owe their brilliant colours to specific carotenoids of complex character; thus *Actinia equina* contains a very beautiful purple pigment, actinorerythrin, which is an ester; the free violerythrin, $C_{40}H_{56}O_6$, is characterized by the intense blue colour of its solution in organic solvents. Again, from *Anemonia sulcata* a still more oxygenated pigment, sulcataxanthin, $C_{40}H_{56}O_8$, has been isolated.

Carotenoids have also recently been discovered in bacteria. Thus the purple rhodovibrio bacteria have been shown by Karrer to contain a series of probably six closely related pigments. Of these, rhodoviolascin, $C_{42}H_{60}O_2$, has been clearly characterized, and constitutes the first known methylated xanthophyll.

(To be continued.)

The Earthquake Research Institute of Japan

By Dr. Charles Davison

THE first Japanese earthquake known to us occurred in A.D. 416. For many years, the chronicle of its successors is naturally incomplete, but, with the nineteenth century, the entries become more frequent; how full they are is evident from Omori's studies of the after-shocks of the great earthquakes of 1830, 1847 and 1854. With the Yokohama earthquake of 1880, the investigation of the earthquakes on modern lines began. Though not of great strength, the shock was the first to arouse the interest of the English professors then living in Tokyo. A few months later, the Seismological Society of Japan was founded by the late Prof. J. Milne, and the admirable work done by him and his colleagues during the next twelve years was continued and expanded by the Imperial Earthquake Investigation Committee and the Earthquake Research Institute.

For the next change, another earthquake was responsible, that of Mino-Owari on October 28, 1891. The widespread damage caused by this great earthquake led to the foundation in the following year of the Imperial Earthquake Investigation Committee, the aims of which were of a practical nature, namely, to discover, if possible, whether the occurrence of earthquakes can be foreseen, and to devise methods of lessening their destructive power. How great was the advance along the second line and how valuable were the contributions of the Committee towards our knowledge of earthquakes in general is clear from the journals that it published and especially from the long series of memoirs that appeared under the name of Prof. F. Omori.

In 1926, shortly after the publication of the valuable reports on the great earthquake of 1923, the Investigation Committee ceased to exist, and its place was taken by the Earthquake Research Institute, with its home, as before, in the Imperial University of Tokyo. Why the change was made is not quite clear, unless it was felt that the work could be carried on more satisfactorily by younger

men. The aim of the new Institute was stated to be scientific research on earthquakes. The first director was Prof. K. Suyehiro, who, on his death in 1932, was succeeded by Prof. M. Ishimoto. In its first year, the staff of the Institute consisted of thirteen members, several of whom had been connected with the Investigation Committee. During the last five years, the number of active members of the Institute was thirty-nine.

When the volumes issued by the Institute are compared with those of its predecessor, two welcome features are manifest—the extraordinary increase in the number of students of pure seismology, and the large number of memoirs written by two or more authors. During the first three years, the new *Bulletin* appeared twice a year, but in 1929 and after it was issued quarterly. By the end of 1936, fourteen ordinary volumes were completed, as well as three supplementary volumes containing papers and reports on the Sanriku seawaves of 1933, the typhoon of 1934, and the Formosa earthquake of 1935. Altogether, the seventeen volumes include 504 memoirs by ninety authors and number 7,646 pages with 1,023 plates. In the first four volumes, three out of every five papers were written in Japanese with summaries in English or French; but, in the last ten volumes, the ratio, fortunately for Western readers, fell to one in five.

Since the Institute began its work, there have been four great earthquakes in the Japanese empire—those of Tango in 1927, Idu in 1930, Sanriku in 1933 and Formosa in 1935—and, on each of these, series of valuable reports are printed in the *Bulletin*. Other earthquakes of less, but still destructive, intensity are also described in one or several papers, such as the Etigo earthquake of 1927, the Kaga earthquake of 1930, the Noto earthquake of 1933, the Idu earthquake of 1934, the Siduoka earthquake of 1935 and the Kawati-Yamato earthquake of 1936. These are probably the most important Japanese earthquakes of the

years 1924-36, but Western readers would be grateful if they could be supplied with an annual list of all the stronger Japanese earthquakes.

For an important section of the earthquakes, those that are sensible in Tokyo, the Institute provides valuable quarterly *Seismometric Reports*. In 1924, the capital was surrounded by a network of nine seismological stations at various distances up to 64 miles. By 1935, the number of stations had risen to thirteen, all within 83 miles of Tokyo. From the durations of the preliminary tremors at three or more stations, the position of the epicentre and the depth of the focus can be determined. During the twelve years 1924-35, the *Reports* contain the records of 766 earthquakes; thus, on an average, one earthquake was felt in Tokyo every 5.7 days. Of the total number, the position of the epicentre was estimated in 699, or 91 per cent, and the depth of the focus in 553, or 72 per cent. All the epicentres are plotted on small maps, annually for the first seven years, quarterly for the last five. Most of the shocks were of slight intensity, and only four reached destructive strength at any one of the stations.

Similar observations, though on a less extensive scale, are made whenever a great earthquake occurs. Immediately after the Tango earthquake of March 7, 1927, members of the Institute were dispatched to the central district, and portable tromometers were installed at three stations near the epicentre on March 11 and 12, by which 1,327 after-shocks were recorded by the end of July 1928. Of these shocks, many were very slight, but 520 were registered at three stations, and the position of the epicentre was found for 482 shocks, and the depth of the focus for 477. Again, soon after the remarkable earthquake swarm at Ito began in the spring of 1930, tromometers were erected at five surrounding stations and, later on, near the adjacent centre of the Idu earthquake of November 26, 1930. In both series, the earthquakes were so numerous, several hundreds sometimes occurring on one day, that no detailed list of them has been published.

In both the Tango and Ito districts, tiltmeters, designed by the present director, Prof. M. Ishimoto, were erected in the neighbourhood of the tromometers. It was found that, before even moderately strong shocks, a perceptible tilting of the ground was revealed by these instruments. Thus, it is not too much to hope that, before many years are past, such records may provide trustworthy forecasts of coming destructive earthquakes.

In no other country have re-surveys after great earthquakes been carried out with such frequency and method as in Japan. At the suggestion of the Institute, new lines of levelling were made by the Land Survey Department of the Japanese

Army across the central areas no less than five times after the Tango earthquake of 1927 and the Ito earthquake swarm of 1930, and in many districts without the accompaniment of recent earthquakes. Re-triangulations of the central areas have been carried out after the Kwanto earthquake of 1923, and the Tango and Idu earthquakes. The repeated levellings in some districts have shown that the crust is broken up into blocks, 4-6 miles across, and that each block moves more or less independently of its neighbours. The mapping of the blocks is perhaps most detailed in the Boso peninsula and the Kwanto plain, both forming parts of the region displaced during the great earthquake of 1923.

Some of the phenomena of earthquakes have been closely studied, especially the remarkable seawaves of the Sanriku earthquake of 1933 and its predecessors, as well as the *kase-tunamis* or non-seismic seawaves that were raised by the great typhoon of 1934, and these studies have suggested precautions that, on future occasions, may lead to the saving of many thousand of lives. Luminous phenomena have been so widely observed with the Idu earthquake of 1930 and the Sanriku earthquake of 1933 that little doubt can now be felt as to their reality or their connexion, direct or indirect, with the earthquakes. Many curious and interesting observations have been recorded on the abundance of fishes caught after earthquakes, and on the relations between earthquakes and thunderstorms or the atmospheric pressure gradient. Though mainly concerned with theoretical studies, members of the Institute have also contributed to our knowledge of the vibrations of various types of buildings, of one story to eight stories in height. Many experiments have been made on artificial earthquake-waves, on the deformation of sand-masses by lateral pressure, and on seismic seawaves. The eruptions of volcanoes all over Japan have been investigated, especially those of the Komagatake in Hokkaido and of the Asama-yama in central Japan. Lastly, one of the most remarkable features of the fourteen ordinary volumes is the series of nearly one hundred mathematical memoirs, dealing as a rule with theoretical problems, but touching also on others of a more practical aspect in the vibrations of various types of buildings and the propagation of seawaves and seiches.

REFERENCES

- Summaries of much of the work described above will be found in the following pages of NATURE: Earthquake Research Institute, 119, 256; 125, 868; 130, 232, 772; reports on Japanese earthquakes, 122, 36, 976-977; 123, 295-296; 124, 633; 129, 404, 766-767; 132, 681; 134, 31, 820; 137, 240; 138, 171, 353, 1063; earthquake-swarms, 126, 326, 971; 131, 136; seismometric reports, 134, 329; 136, 919; 138, 252; crust-displacements, 119, 254; 126, 923-924; 130, 440; 132, 356; 134, 940; 135, 273-274; 136, 993; 137, 281, 1000; tilting of the ground, 119, 869; 124, 633; movements of crust-blocks, 129, 321; 133, 536; luminous phenomena, 128, 155; 129, 27; 130, 969; frequency of sunspots and earthquakes, 126, 895; vibrations of buildings, 129, 693; typhoon of 1934, 136, 544; eruption of Komagatake, 126, 487.

Obituary Notices

Sir James Currie, K.C.M.G., K.B.E.

IT is with deep regret that we have to record the death of Sir James Currie. Sir James had gone to Cambridge to attend a conference on animal pathology, and was staying with Mr. Will Spens, the master of Corpus Christi College. He retired at 11 p.m. on March 16, and on the following morning was found dead in his room.

Sir James had a distinguished career of public service, and, as he would have wished, died in harness. Son of the Rev. James Currie, principal of the Church of Scotland Training College, he was educated at Fettes (where he played in the first Rugby XV and the first cricket XI), and he obtained an exhibition at the University of Edinburgh and a scholarship at Lincoln College, Oxford, in 1888. After going down, he gained teaching experience at one of the schools of the Scottish Education Board in Edinburgh, his native town. His great opportunity came in 1899 when he joined the Egyptian Education Service. He embraced it magnificently. In the following year he was appointed principal of the newly founded Gordon College in Khartoum and director of education in the Sudan.

As a start, Currie formed a school for the training of the Sudanese as teachers. Inspired by Lord Cromer, many of whose attributes he possessed, he soon won his way into the hearts of the Sudanese. He was appointed a member of the Governor-General's council, and his work in the Sudan was perhaps his greatest achievement.

Relinquishing his posts in 1914, Currie returned to England, where he went in for farming; but during the Great War, in 1916, he undertook, as director of the new Labour Supply Department, the training of munition workers, and in 1918 he joined the Ministry of Labour, again in a voluntary capacity, as controller of the training department. He originated the idea of Government instructional factories, and when he retired, early in 1921, more than 25,000 disabled ex-service men had passed through his hands.

In the same year Currie was appointed director of the Empire Cotton Corporation, and a year later a governor of the Imperial College of Tropical Agriculture, to the chairmanship of which he succeeded in 1927, after the death of Sir Arthur Shipley.

Scientific men were needed for the development of cotton-growing within the Empire, and Sir James initiated the system of scholarships for post-graduates tenable at the College in Trinidad, an example which was followed later by the Colonial Office under the Milner-Lovat Committee's scheme. Much work had to be done. As E. H. C. wrote in *The Times*: "Cotton was to be grown in a dozen different countries, each with a different climate and different conditions. There would be no uniform cotton seed which would suit each and all. First must come research in each country, experimental farms,

trials of various seeds, knowledge of constituents of soils. So, just as he had first to train teachers in the Sudan before he could have schools, he must now concentrate on soil-chemists and plant-breeders before he could have seed which would not bankrupt Colonial farmers. No other man in the Empire would have seen this so clearly or have understood so well how to give practical effect to what he saw."

Sir James was also a governor of the Imperial College of Science and Technology, a member of the council of Marlborough College and chairman of the directors of Dauntsey School. To the Cotton Corporation and the Imperial College of Tropical Agriculture especially, his experience of education and research and his great powers of administration proved of inestimable value.

Sir James possessed exceptional strength of character. He had also a rich fund of humour, and this often found expression in original though apposite comments which relieved the monotony of many meetings which he attended. All who worked with him and for him, loved him and will treasure his memory.

Sir James was made C.M.G. in 1912 and a K.B.E. in 1920, and was promoted to K.C.M.G. in 1933. He was married in 1913 and is survived by his wife, Hilda Beatrice, daughter of the late Sir Thomas Hanbury of La Mortola, Italy.

Dr. Elihu Thomson

BY the death of Elihu Thomson on March 13, the world has lost one of the greatest of the pioneers of the practical applications of electricity. He was born in Manchester, England, on March 29, 1853, but his father, who was a skilled mechanic, emigrated to Philadelphia, Pa., in 1858. He was educated there and attended the Central High School, a well-known technical college. His love for experimenting and invention was probably inherited from his father. At first his chief interest lay in chemistry; after he had served his time as an analyst at a factory he returned to the High School to teach chemistry and retained this post for ten years until 1880.

Prof. M. B. Snyder tells how one day in 1875 Thomson transmitted ether disturbances from the first floor of the building to the sixth floor, where his detector was a brass door knob and an ordinary lead pencil. When the apparatus on the first floor was working a stream of delicate sparks passed between the point of the pencil and the knob. This happened twelve years prior to Hertz's celebrated verification of Maxwell's theory.

In 1880, Thomson went to New Britain, Conn., as electrician for the American Electric Co., and two years later in conjunction with Edward J. Houston founded the Thomson-Houston Electric Co. at Lynn, Mass. In 1892, this company was merged with the

Edison General Electric Co. to form the General Electric Co. (America), the largest manufacturing company of electrical equipment in the world. Thomson retained his post as director of the large laboratory at Lynn, which was renamed after him, the Thomson Laboratory.

Thomson made more than seven hundred inventions, some of which have led to great developments and many theoretical discoveries. He discovered that the resistance of the electric arc varies inversely with the current. He was the first to utilize a magnetic field to move the electric arc, a method which is used in magnetic blow-out switches and electric safety valves. A notable discovery was that a copper ring placed in front of an a.c. magnet was strongly repelled, a fact which he applied to the development of repulsion motors which are much used in industry. He was the pioneer of high-frequency apparatus, making the first dynamo of this type in 1890. In 1886, he invented the art of electric welding by the resistance method. The art of welding has developed very rapidly since this date. Ships, buildings, bridges, etc., are now being welded instead of being riveted and bolted. It has also proved of great value when designing aeroplanes and large motor vehicles. His inventions show great novelty of design. The Thomson-Houston dynamo for arc lighting had a spherical armature, cup-shaped field magnets and a three-part commutator. He made most useful contributions to the field of radiology and was the first to make stereoscopic X-ray pictures.

In 1884, Dr. Thomson married Miss Mary Peck of New Britain, Conn., by whom he had four sons. Mrs. Thomson died in 1916, and seven years afterwards he married Miss Clarissa Hovey of Boston and lived at Swampscott near Lynn, where he continued his inventive work.

Elihu Thomson received many honours for his electrical and scientific work from countries all over the world. He made many friends when he was president of the International Electrical Congress at St. Louis in 1904 and of the International Electro-technical Commission which met in Turin in 1911. The writer remembers how feelingly Elihu Thomson spoke of Prof. Silvanus Thompson when a portrait of the latter was presented in 1923 to the Institution of Electrical Engineers. He said that he felt that the late Prof. Silvanus Thompson was in many respects nearer to himself than any other man. He was successful not only in electrical work, but as an optician, a musician and an artist he had also attained distinction. He felt that in his own way he was humbly following in Thompson's footsteps.

When he was presented with the Kelvin Medal in 1924 by the leading engineering institutions in Great Britain, Elihu Thomson said that Kelvin was his ideal, as an influence and example that was not to be estimated by ordinary standards. Kelvin was lovable as a man, and unequalled as a scientific expert. Thomson regarded him as the earliest and greatest electrical engineer. In 1924, the University of Manchester, his native city, conferred on Thomson the honorary degree of doctor of science. At the festivities which took place at the World Power

Conference in 1924, he and Mrs. Thomson took a leading part and were esteemed by everyone. Since then, many of us have received at Christmas time from them beautiful photographs of their garden taken in natural colours by a new method invented by Thomson. He will be missed by his many friends all over the world.

A. R.

Baron de Stael Holstein

WE regret to record the death of Baron de Stael Holstein, well known as an Oriental scholar, which is reported to have taken place recently in Peking at the age of fifty-seven years.

Baron de Stael Holstein was formerly one of the largest landowners in the Russian Baltic States; but on being dispossessed by the Revolution, he took up his residence in Peking, where he devoted himself to the study of Sanskrit and Buddhism, of which he had long been an ardent follower, adding to them Tibetan and Chinese. In so doing, he was anxious to bring about a better understanding of the Buddhist canon among the Chinese themselves, and for the furtherance of this object founded, with the co-operation of Harvard University, the Sino-Indian Institute, in which Tibetan lamas were engaged for instructional purposes, but at the same time initiated into Western methods of critical scholarship. With the assistance of American benefactions, he brought together a remarkable collection illustrating Buddhist iconography. His eminence as an Oriental scholar was recognized by the University with which his Institute was connected when he was called to Harvard for a time to occupy the chair of Sanskrit. His literary output was considerable, his work of most enduring value being the publication of a number of Buddhist texts.

Dr. F. P. F. Ransom

DR. F. P. F. RANSOM, who died on February 23 at the age of eighty-seven years, studied pharmacology as a young man in Halle and Marburg with von Behring and H. H. Meyer. They studied immunity, and the pharmacology of tetanus toxin and diphtheria toxin. They obtained evidence that these toxins passed from the periphery to the central nervous system in the trunks of nerves. Ransom also showed that the toxic effects of saponins were largely due to their affinity for cholesterol, and made an active cell-free cholera toxin.

At the age of sixty years, he was elected to a Beit fellowship, and, with Dixon in Cambridge, demonstrated the action of sympathetic and parasympathetic nerves on the bronchi. From 1912 until 1924 he held first a readership and then a chair at the London School of Medicine for Women, and published papers on the effect of caffeine on seeds, on alcohol, chloroform, pilocarpine and other subjects. His wide knowledge of pharmacology was always at the disposal of his colleagues, and he will be remembered as a kind, modest and courteous friend. He spent his last years in retirement in Somerset, and kept up his interest in pharmacology in spite of failing eyesight.

News and Views

Sir William Beveridge, K.C.B.

THE presence in Oxford of Sir William Beveridge, who will return there as master of University College next October, will greatly strengthen the young but vigorous Oxford school of philosophy, politics and economics. No head of a House there, with the exception of Mr. H. A. L. Fisher of New College, has had so brilliant a combination of an academic and public career. At Balliol, where Sir William was an undergraduate, he distinguished himself in mathematics, classics, philosophy and law. Later, he became a fellow of University College. In London he has had a wide experience as administrator, first in the Civil Service and, since the War, as director of the London School of Economics and Political Science. For many years he was at the Board of Trade and the Ministries of Munitions and Food, and there became a great and resourceful authority on problems of labour, unemployment and industrial insurance. To him more than to any other is due the organization in Great Britain of 'Labour Exchanges'. He has latterly been chairman or member of several important commissions or tribunals dealing with industrial wages and insurance. For the last eighteen years he has been a senator of the University of London and was vice-chancellor in 1926-28. He is still comparatively young. His resource and energy, and his wide knowledge of men and affairs, can now be devoted to Oxford for many years.

Social and Economic Problems for Solution

THE group of 150 distinguished public men and women of all schools of democratic public opinion who eighteen months ago published an essay in political agreement in a book called "The Next Five Years" have now submitted a narrower "Programme of Priorities" to cover a period of five years—that is, the lifetime of a Parliament ("A Programme of Priorities". Pp. 12. (Oxford: "Next Five Years Group", 1937.) 3*d.*). The programme is a practical plan applicable to the political and economic situation of England to-day and is submitted for discussion by all those who see the importance of a common effort to serve the nation and strengthen its influence in the world at this critical time. A number of its proposals, such as an extended housing programme by widening the definition of overcrowding, the extension of the milk-in-schools scheme to all elementary schools, or the raising of the school leaving age to fifteen years without exemptions, merely require the tightening of legislation.

OTHER proposals which are put forward in the pamphlet give concrete expression to present tendencies in the Government or to authoritative recommendations in Commissions and reports already submitted to it. They include the provision of

national parks and playing fields, recreational and cultural amenities in connexion with slum clearance and new housing estates, agricultural marketing Acts administered by appointed bodies entrusted with the duty of considering the interests of the community as a whole, the expansion of the national health insurance panel system into a public medical service, the pensioning and removal from the live register of elderly persons who have been unemployed for five years, the location of industries, measures to restore and maintain the personal qualities of the unemployed in the Special Areas, public development schemes, the co-ordination of transport, the freeing of trade by the overhaul of the tariff system, etc., the expediting of the new Factory Act, control over undesirable speculative methods of finance, further State aid for social and economic research and the encouragement of the shorter working week and annual holidays with pay. Under international relations the programme includes a proposal to all European countries to set up a fact-finding commission to examine outstanding problems such as Colonial questions, access to raw materials, the lowering of trade barriers and positive economic co-operation, currency co-ordination, racial minorities and claims to changes in territorial *status quo*, as well as renewed efforts to establish a system of collective security, the limitation, reduction and supervision of armaments and the rebuilding of the League of Nations as the main and consistent object of British policy.

The Social Credit System

UNDER the title "Poverty and Over-Taxation; the way out", the Marquis of Tavistock has published a further account of the Social Credit system (Coventry: *Prosperity Office*, 1937. 6*d.*). Among seven reasons given for the failure of the present financial system, he stresses the way in which science and machinery are destroying the need for human labour, but are increasing the output of real wealth in goods. Because the machine does the work of several hundreds of people, it becomes more and more difficult every year to find work for everyone, and no cure for poverty can be found by attempting to give everyone a paid job in industry. The effect of machinery and fresh scientific inventions is to destroy the demand for human labour, and although new industries are started, fewer and fewer people are needed. Apart accordingly from the necessity of education for leisure, it is urged that the State should direct the banking system to create and issue, *not* in the form of debt, as much money as is required to enable the citizens of the country to buy at a price fair to sellers all that they desire of what industry and commerce can produce or import. Of the three main items in the reform necessary to make money

the servant of industry, aiding the consumption and production of goods, the first is the abolition of the Gold Standard and of any gold basis for the issue of money, since it is goods and not gold which give value to our money. It is suggested that under a policy of National Dividends, a man unable to find work would still be able to live in reasonable comfort without being a burden on others and he would be able to help the man at work by being in a position to buy his goods. It would still pay a man to get work if he could, as wages would be paid extra to National Dividends and a natural check to living on National Dividends would operate because their amount depends on the country's production of goods.

Japanese Institute for Science of Labour

IN view of the importance which labour is commonly regarded as possessing in Japanese competition, the annual report of the Institute for Science of Labour, which was transferred from Kurasaki to Tokyo at the end of 1936, is of considerable interest. The report indicates that much of the work of the Institute follows the lines of work of the National Institute of Industrial Psychology in Great Britain. Among a number of completed researches mentioned in the report are those on the clothing of farmers, syphilis morbidity in villages, psychological qualifications for textile workers, an examination of vocational testing methods, studies on manual dexterity and on the physical fitness of employees, studies on motions and positions in working, on repetition work, psychological differences between skilled and unskilled workers in a weaving factory. Some of the physiological work is on lines similar to that pursued by the Industrial Health Research Board in Great Britain as, for example, the investigations on environmental conditions, such as climate, the effect of occupational activities on basal metabolism, the metabolism of heavy muscular labour or the physiological studies on walking, but in addition the Institute has completed a preliminary research on the daily protein requirements of the nation. Occupational diseases and the prevention of accidents have also received attention, and it is interesting to note from abstracts of publications of the Institute included in the report that scientific workers in Japan are now advocating on scientific grounds raising the minimum age of juvenile labour to at least fourteen years, with special protection up to eighteen years of age.

National Research Laboratories, Ottawa

THE National Research Laboratories at Ottawa now employ about 190 workers organized in five divisions: agriculture and biology; chemistry; physics and electrical engineering, mechanical engineering including aeronautics; and research information, with which is associated a national scientific library service. A review of the year's work recently issued for the National Research Council of Canada stresses the increasing service which is rendered to industry; much of the work carried out in the Division of Biology and Agriculture forms part of large co-

operative research projects, mainly in collaboration with the Department of Agriculture but also with the universities and similar organizations. A low-temperature laboratory has been equipped, and physical conditions for dechilling boxed poultry without condensation have been established. Research on malting barley is being carried on in co-operation with industry, and a comprehensive review of the literature on chemical weed killers is being published as a guide to research in this field.

THE Division of Chemistry is in organized relations with the laundering and dry-cleaning industry, the asbestos industry, the manufacture of basic refractories, and to a slight extent the woollen and sugar industries. In an investigation on the chemical principles in certain groups of wild plants native to Canada, a method of synthesizing certain plant hormones which stimulate plant growth, including root formation on cuttings, in a remarkable way, was discovered. An extremely efficient distillation column was built in the laboratories during the year and its application in the oil-refining and synthetic chemical industries, the coal tar industry, etc., is being investigated. The snow resistance of aircraft skis has been thoroughly investigated by the Division of Mechanical Engineering, as well as the stalling of heavily tapered wings on modern aircraft. A new heating system for refrigerating cars has been developed, as well as a new machine for converting aerial photographed information into a map. Radio methods in weather forecasting are being investigated, the Physics and Engineering Division is also giving a considerable amount of attention to the development of new or improved methods or instruments for measuring sound absorption, gauges, voltage in X-ray work, grading of colours for fastness, etc.

Educational Research in the United States

EDUCATIONAL research in the United States proceeds on a scale never hitherto approached in that or any country. Some idea of the volume of work in this field may be gathered from a "Bibliography of Research Studies in Education, 1934-35", issued from the United States Office of Education (Washington: Govt. Printing Office. 25 cents). Herein are listed 2,971 studies reported by 145 institutions, including 384 doctors' dissertations, 2,368 masters' theses and 219 studies reported as faculty research. An introductory note mentions the following as "especially timely topics" of some of the theses; apprentice training, business depression, correlation of school subjects, crime prevention, exploratory courses, leisure-time activities, open forums, orientation courses, teachers' strikes, rehabilitation of the disabled, traffic schools, new systems in several foreign countries. Another favourite subject for educational research in America is the technique of reading. Fifty-two of the studies listed deal with investigations such as the measurement and improvement of silent reading among college freshmen. It seems to be not unusual for a reading test to form part of the college entrance examination, and it has been found that

many students are seriously handicapped in their work by remediable faults in their modes of reading. Within a day or two of the publication of this bibliography appeared No. 1 of vol. 24 of the University of Colorado Studies containing abstracts of 136 theses for higher degrees. An analysis of the subject headings of the theses affords further evidence of what might almost be called the rage for educational research prevalent in some American universities, for no fewer than 47 of the theses are devoted to research in this field.

Records of Bushman Art

THE Department of the Interior of the Union of South Africa and the Commission for the Preservation of the Natural and Historical Monuments, Relics and Antiquities of South Africa have issued an official circular inviting the co-operation and assistance of members of the public in recording and preserving examples of Bushman rock-painting and drawing. In asking observers to forward such records to Prof. C. van Riet Lowe, as director of the Bureau of Archaeology at Johannesburg, the circular points out that although the existence of a large number of such examples of Bushman art is already known, it is certain that the list is by no means complete, while time, exposure to weather, as well as acts of vandalism are obliterating many of them year by year. In order that the records may be as complete as possible, the circular enumerates the data which are essential for the purpose of accurate record, as well as for archaeological study, and gives instructions on the best methods of taking photographs and squeezes in varying conditions. The circular, as received, is accompanied by an excellent and extremely instructive map, showing the distribution of the known sites on which examples of the paintings and engravings have been recorded, as well as sites which have been proclaimed for preservation by the Commission for the Preservation of Natural and Historic Monuments.

Fire Precautions in Electrical Stations

SERIOUS fires from electrical plant in power stations are fortunately rare in Great Britain, but during the last few years there have been several disastrous fires both at home and abroad, and so the paper on fire precautions by F. C. Winfield read to the Institution of Electrical Engineers on February 11 is a useful one. In electrical supply it is recognized that the maintenance of this supply is the outstanding requirement. This is usually done by duplicating all the principal cables supplying the current, and also some of the plant. Since all electrical plant is subject to the two risks of fire and explosion, this provision does not secure the desired maintenance of the supply unless measures are taken to ensure that such duplicates cannot be simultaneously impaired. It is necessary therefore to provide physical separation of electrical duplicates by dividing them up in separate buildings or enclosures. Brick walls and reinforced concrete construction have excellent fire-resisting properties. Pitched roofs supported by steel

trusses should be protected by a fire-resisting inner ceiling. All windows should be of wired glass and all internal doors of fireproof self-closing design. The development of the oil-less circuit and breaker on the Continent is a step in the right direction. An important factor in fighting an oil fire is the dense black smoke, which impedes or prohibits access to the seat of the fire. This is a very serious consideration in dealing with fires which occur in the inner regions of large power stations. For this reason it is recommended that all large transformers or heavy switch-gear should be mounted in separate buildings or in chambers opening to the outer air and sealed off from the inner side. Unfortunately, no practical method of routine testing has yet been devised by means of which the failures that produce fires can be anticipated.

Underwater Power and Telephone Cables

IN the course of developing underground cable networks, the engineer has sometimes to negotiate waterways and harbours. For large waterways three methods are used. The first is to make a special cable tunnel. But the expense of construction is heavy, and is only justified when a large block of main cables has to be taken across. Examples of this type are the crossings under the Thames at Barking, Deptford and Battersea and underneath the Tyne at Newcastle. The second method is to dredge a trench in the river bed in which the cables are laid directly, and the third method is to lay them in the bed of the waterway without recourse to dredging. The second method is, when practicable, preferable to the third method, especially in navigable waterways, where the ships' anchors damage them. In certain cases, owing to the width of the waterway or because the nature of its bed renders dredging impracticable, the third method is employed. In the Engineering Supplement to the *Siemens Magazine* of March, it is pointed out that when this is done in running or tidal waters, a new problem arises. No matter how carefully the cable is laid, it may at any time, due to the shifting of the bottom, be left suspended between two points. In this condition, it is subject to high-frequency vibrations set up by the current. These vibrations are very harmful to the lead as they rapidly produce inter-crystalline fracture and failure due to ingress of water. Messrs. Siemens have successfully combated this trouble by a special type of cable. A rubber hose protection is applied between the lead sheathing and the armouring. This damps out harmful frequency vibrations before they reach the lead.

Progress in Marine Radio Communication

THE first practical application of radio provided communication with ships at sea over distances and under conditions which made all other forms of communication impossible. More than thirty-five years have elapsed since that first application, and marine radio still remains unique for this particular purpose, so important to commerce and so essential to safety. In no other field, except that of air trans-

port, is radio irreplaceable by other forms of communication. A general survey of the present state of the art of marine radio communication was given at a meeting of the Wireless Section of the Institution of Electrical Engineers on March 3, when Commander F. G. Loring and Messrs. W. L. McPherson and W. H. McAllister presented a paper entitled "A Survey of Marine Radio Progress, with Special Reference to R.M.S. *Queen Mary*". The first section of the paper comprised a short summary of progress during the last five years, with particular reference to the nature and volume of traffic, the types of communication involved, and the increasing use of direction-finding equipment by navigators. Next the types of equipment fitted in cargo vessels and the smaller class of passenger vessels were described. An account was then given of the radio problems encountered in the 'express steamer' class of vessel, and the paper concluded with a detailed description of the radio station of R.M.S. *Queen Mary*, the latest representative of its class. This installation comprises four transmitters and nine or ten receivers; the control room can handle four independent duplex circuits, and provision is made for high-speed transmission and reception, and simultaneous communication on both telegraphy and telephony with both sides of the Atlantic. The results of the experience obtained with this equipment have shown that in spite of the difficulties peculiar to ship installations of this character, by careful engineering, a good approach can be made to the operating efficiency of a large land station.

Use of Diesel Locomotives in Mines

In coal and metalliferous mines, as the working faces advance from the shafts, there is a desire to transport workmen to within easy reach of their working places and there is a large field of usefulness open to safe and convenient locomotives suitable for this purpose. Electric trolley, compressed air, storage battery, benzol and Diesel locomotives have been used, and it is interesting to note that tests have been carried out by the Ruhr Testing Station officials which show that Diesel locomotives are safe for use in mines. An investigation has been carried out by Messrs. George S. Rice and F. E. Harris of the United States Bureau of Mines, and a report has been published under the title of "Diesel Mine Locomotives—Development and Use in European Coal Mines" (a Publication of the Department of the Interior, United States Bureau of Mines, November, 1936). It is stated in this report that provided a reasonable amount of air is circulated along the roadways where these Diesel locomotives are in use, dangerous percentages of carbon monoxide do not occur if the machines are maintained in a good working order. These locomotives are being used in American mines, and they are being substituted for benzol locomotives in mines in Germany, Belgium and France. At a colliery in Scotland, a Diesel locomotive has been on trial since 1935. Another large colliery company in Yorkshire is contemplating using Diesel locomotives for carrying men from the pit bottom to points near

the face, and the necessary investigations are at present being made. In Great Britain special permission is required to introduce internal combustion engines into mines by Section 58 of the Coal Mines Act, 1911, which prohibits the use of these engines in underground workings without permission.

Air Survey

THE Air Survey Committee grew from a suggestion of the Army Council in 1919, and now includes representatives of the War Office, Air Ministry, Admiralty, Ordnance Survey and Department of Scientific and Industrial Research. The Committee's second report (Report of the Air Survey Committee No. 2. H.M. Stationery Office. 4s. net) reviews at length the methods of air survey and the apparatus at present available. A useful appendix analyses the cost of air survey. Conditions, of course, vary, and the estimate is based on the existence of an air survey organization on a permanent basis undertaking operations on a large scale. It is assumed that the area is undeveloped and consequently difficult for land transport. Under these conditions the cost of the survey is estimated for an area of one million square miles which would entail six years work for completion of the air photography. For this, five aircraft in action and one in reserve would be required. This fleet could do 2,000 hours of photographic flying each year. The total cost, which of course includes the cost of photographic material, works out at twenty-three shillings per square mile, but considerably more if a smaller area is surveyed, rising to 180 shillings per square mile for an area of 500 square miles. These must be taken as average figures, and the cost would be much higher in urbanized areas. The production of the maps is additional to these costs.

Works of Charles Darwin in Russian

THE fiftieth anniversary in 1932 of Charles Darwin's death was marked with perhaps greater solemnity in the U.S.S.R. than elsewhere, since both Engels and Lenin adopted and popularized Darwin's evolutionary idea. Until that time, only more or less abbreviated translations of Darwin's works had been available to Russian readers, and most of them were out of print. It was therefore decided that a new translation should be published, which had to be the most complete of all editions of Darwin's works existing in any language. The preface to the first volume, published in 1935 by the State Publishing House for Biological and Medical Literature, Moscow and Leningrad, points out the necessity for such an edition, particularly at the present time when "the economic crisis and the political and spiritual reactions caused by it, not only call for a complete oblivion of Darwin, but when the bourgeoisie, in its futile struggle against darwinism, more and more often invokes the darwinism's decrepit antithesis—religious teachings on the creation of the world".

ACCORDING to the plan, the edition will comprise twelve volumes, and will include the translations of all books, and all papers by Darwin, except some

highly technical ones from which only excerpts will be published. Every separate work will be supplied with an introduction by an expert in the particular problem, who is in many cases responsible for the actual translation, or for editing it, as well as for commentaries that serve to explain various points, to bring up to date the nomenclature of plants and animals, etc. The first volume that appeared in 1935 contains the "Journal of Researches, etc." supplemented by the "Diary" (as published by Norah Barlow); the second, printed in 1936, includes a series of zoological works, the book on earthworms, and a series of geological works, especially that on the formation of coral reefs. The editorial work is done very thoroughly, but the appearance of the book leaves much to be desired, as the paper (particularly in the first volume) is of indifferent quality, affecting the illustrations, which are reproduced mostly from original English editions. When (and if) all the promised twelve volumes are published, it will be possible to judge the whole enterprise in greater detail.

Recent Acquisitions at the Geological Museum

THE Geological Museum has recently put on exhibition two new dioramas illustrating the occurrence and exploitation of gold ore at the Lake Shore mine in the Timiskaming District of Ontario. This mine is the largest gold producer on the American continent, and one of the most important in the world. One of these dioramas introduces a new technique, in illustrating the geological structure to a depth of 4,500 feet, as well as the general surface topographic features. The dioramas have been presented by Mr. Harry Oakes, who originally staked the property. Among other recent additions to the collections are a jade hei-tiki, carved by the Maoris, the gift of H.M. Queen Mary; a very extensive collection of polished Italian marbles, presented by Mr. Percy C. Webb; and a magnificent group of deeply coloured amethyst crystals from Brazil, loaned by the managers of the Royal Institution. The Geological Society of London has presented a group of large pillars of basalt, from the Giant's Causeway in Antrim; an *Ichthyosaurus* from the Lower Lias of Barrow-on-Soar; a very fine slab of Wenlock Limestone with *Periechocrinus moniliformis*, etc., collected by the late Earl of Dudley; and a beautiful specimen of *Pentacrinus briareus* Miller from the Lias of Lyme Regis, collected by Sir H. T. de la Beche, the first director of H.M. Geological Survey. Within recent months, the Museum has added to its permanent exhibits on economic geology displays on abrasives, moulding sands, refractory materials, and other subjects of industrial interest.

Codes Used in Weather Forecasts

"WIRELESS WEATHER MESSAGES, 1937" (Publication M.O. 252, tenth edition. London: H.M. Stationery Office. 1s. 6d. net) has the sub-title "Particulars of Meteorological Reports issued by wireless telegraphy and wireless telephony in Great Britain, Gibraltar, Malta, Middle East and Iraq";

and this defines its scope. It incorporates changes in some of the specifications of the International Code used for meteorological messages that were adopted at the International Meteorological Conference held at Warsaw in September 1935, changes which came into operation on January 1, 1937. There are two sections giving, respectively, details of the codes used for weather forecasts for aviators and details of the codes used for messages giving special information supplementary to routine reports for aviation. These sections follow the main body of the publication dealing with the main transmissions from shore stations and ships. In spite of some economy of space that has been introduced in setting out the details of individual transmissions, this publication now contains about ninety pages, and its growth in recent years corresponds with that of aviation and of the international exchange of meteorological information.

Carnegie Trust for the Scottish Universities

THE Carnegie Trust for the Universities of Scotland has recently published its report for 1935-36. Grants to universities and extra-mural institutions amounted to £51,460, expenditure on assistance in payment of class-fees to £53,971, grants under the Trust's scheme for endowment of research to £17,880. The progress of recovery from economic and industrial depression in Scotland is reflected in the exceptional number of resignations of fellows and scholars due to their appointment to paid positions. Of thirty-two fellows and scholars in chemistry, organic and physical, fifteen resigned, some almost at the commencement of their appointment periods. Another indication of prosperity is the sharp rise in the amount of voluntary repayments by former recipients of aid from the Trust. These repayments amounted to £2,362, the largest amount so received by the Trust since 1928-29, and only exceeded in that year and 1926-27. The aggregate amount of such repayments since the inauguration of the scheme in 1901 is £38,000.

Rearing Marine Organisms in the Laboratory

THE *Aquarist and Pond-Keeper* of January-February 1937, besides a number of other interesting papers, contains an article by Mr. Douglas P. Wilson, naturalist at the Marine Biological Laboratory, Plymouth, on the plunger jar for rearing marine organisms. This is a piece of apparatus much used in the Plymouth Laboratory, originally planned and used by Mr. E. T. Browne for rearing medusæ, the main idea being to create a definite rhythmical movement in the aquarium by means of a glass plate, the plunger, manipulated by a siphon. All workers at Plymouth are familiar with the plunger jar, and it is now used in many laboratories. Numerous well-known researches have been successfully conducted by its aid; echinoderms, molluscs, crustaceans, worms, have all been reared, and it is fit that the plunger-jar should be introduced to all those who wish to keep marine animals. Mr. Wilson, who has himself reared successfully several sea-worms from the egg, describes how this can be done.

Annual of the Astronomical Observatory, Madrid

THE receipt of the usual annual astronomical handbook from Madrid ("Anuario del Observatorio Astronómico de Madrid") in the unusual circumstances that exist to-day in Spain, calls for at least a brief comment. The 1937 handbook contains current tabular matter that is likely to be of general use to observers in Spain—astronomical elements, tables of sunrise and sunset and of moonrise and moonset (in each case for Madrid), planetary phenomena, solar and lunar eclipses, positions of the principal nebulae and double stars, etc. A set of monthly charts is included to illustrate the night-skies as seen by an observer at Madrid, and a concluding chapter describes the use of wireless time-signals for the dissemination of standard time and the application of the signals to longitude determinations.

Société Astronomique de France (1887-1937)

THIS year, the Société Astronomique de France celebrates its fiftieth anniversary, and the January issue of *L'Astronomie* recounts the circumstances of its inception on January 28, 1887, owing chiefly to the efforts of M. Camille Flammarion. The aim of the new society was to foster in France an interest in astronomy and to establish a link mainly between non-professional astronomers in all parts of the country. The society now has a membership of 5,000, and includes astronomers from many countries; it possesses an observatory in Paris which members may use, and records its regular meetings and general activities as well as publishing papers in its monthly periodical, *L'Astronomie*. We welcome this opportunity of extending our congratulations.

The Pasteur Institute of Southern India

MAJOR IYENGAR, director of the Pasteur Institute of Southern India, Coonoor, has issued his annual report for the year ended March 31, 1936. The number of patients who underwent a full course of treatment at the Institute was 433, and 102 patients received incomplete treatment for various reasons. There were no deaths from hydrophobia among those treated at the Institute. In addition, more than 14,000 courses of antirabic vaccine were issued to outlying centres. Details of the course of treatment are given; Semple's carbolized 5 per cent sheep vaccine was in use throughout the year, prepared from Paris fixed virus.

Announcements

PROF. HEINRICH WIELAND, professor of chemistry at Munich, has been elected a corresponding member of the Physico-Mathematical Section of the Prussian Academy of Science.

SIR HARRY LINDSAY, director of the Imperial Institute, has been nominated as president of the Association of Special Libraries and Information Bureaux, (ASLIB), for the year 1937-38. The Association will hold its fourteenth Annual Conference at Gonville and Caius College, Cambridge,

during the week-end beginning September 24. Particulars may be obtained from the Secretary of the Association, 31 Museum Street, London, W.C.1.

MR. T. G. ROSE has been appointed general director of the National Institute of Industrial Psychology, to collaborate with Dr. C. S. Myers, the principal, who will retain the position held by him since the inception of the Institute sixteen years ago.

LORD SNELL will open the Studio of Animal Art in the Zoological Gardens of the Zoological Society of London, Regent's Park, N.W.8, on April 21 at 2.30.

A BUST of Prof. Babes, founder of the first Pasteur Institute in Bucharest, who died ten years ago, was recently unveiled in Bucharest, when memorial addresses were delivered by Profs. Bacalogliu, Ciuca, Manicatide, Marinesco and Proca.

THE thirty-ninth annual conference of the Institute of Public Cleansing will be held at Margate from June 14-18. Further information can be obtained from the honorary secretary of the Institute, 160 Buckingham Palace Road, S.W.1.

AN International Conference on "Esperanto in Modern Life" will be held in Paris on May 14-17. Participation in the Conference is free. Further information can be obtained from the secretariat, Conférence Internationale (L'Esperanto dans la Vie Moderne), 34 Rue de Chabrol, Paris, 10^e.

THE thirty-fifth annual session of the South African Association for the Advancement of Science will be held at Windhoek, South-West Africa, under the presidency of Lieut.-Colonel C. Graham Botha, on July 5-10. Further information can be obtained from Dr. C. F. Juritz, Department of Agriculture, P.O. Box 3, Capetown.

A COMMITTEE has been formed by the French Air Ministry to deal with the requirements of the air force and to secure the best possible adaptation of the human organism for military aerial navigation. The functions of the committee will be first to express opinions on biological and medical problems brought before it by the Air Minister, and secondly to supply the Minister with useful suggestions regarding biological questions relating to military aviation.

THE triennial award of the Coopers Hill War Memorial Prize and Medal will be made this year by the Institution of Electrical Engineers, which invites members to submit for consideration a paper on any subject coming within the scope of electrical science or electrical engineering and their applications. Further information can be obtained from the Secretary, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

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. 634.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Effects of Traces of Metallic Ions on Monolayers

IN a recent communication to NATURE¹, Prof. W. D. Harkins and Dr. R. J. Myers have directed attention to the effects of minute traces of metallic ions on the behaviour of monomolecular films at the surface of aqueous solutions.

It may be of interest to investigators in these fields to add that the effects of such traces of impurities are not always confined to modifying, to a greater or less extent, the physical characteristics of the films, but may on occasion play a predominating part in chemical reactions taking place in the films. While treating with reserve all results on unbuffered aqueous solutions, since marked changes in the characteristics and reactivities of films of various types can be effected by small changes in the pH of the underlying solutions, profound effects on the reactivity of molecules in the boundary state can on occasion be observed due to the presence of even slight traces of metallic ions, especially nickel or copper.

The importance of minute traces of metallic ions is clearly demonstrated in the examination of photochemical reactions in monolayers^{2,3,4}. In the case of the photochemical hydrolysis of monolayers of stearic anilide on 5N sulphuric acid substrates, it has been found that the velocity of an anomalous 'fast' reaction was reduced to a normal value by the addition to the substrate of potassium cyanide in a concentration of the order of $M/2000$. In the photochemical decomposition of monolayers of α -hydroxystearic acid on $N/100$ sulphuric acid substrates, probably with splitting off of carbon dioxide, the unsensitized process appears to occur only with radiation of wave-lengths shorter than 2400 Å., but sensitization to the wave-length 2537 Å., isolated by means of a monochromator, can be produced by the presence of sub-analytical quantities of nickel ions; for example, 3 γ of nickel in 500 c.c. of substrate for a film of area 100 sq. cm. Evidence was obtained that sensitization occurred only after the formation of a complex which appears to consist of one molecule of α -hydroxystearic acid and one nickel atom. Further, it is probable that the photochemical oxidative and hydrolytic changes in monolayers of proteins, such as ovalbumin, can be sensitized to wave-lengths greater than 3350 Å. by traces of nickel and copper, although the possibility of unsensitized processes at these long wave-lengths cannot be entirely excluded.

On occasions the source of copper contamination has been traced to the distilled water, and in this it can be estimated by its catalytic activity on alkaline sulphite oxidation.

The effects due to the adventitious presence of traces of the alkaline earths are much less marked when the films are on acid substrates, as Langmuir

has pointed out. However, some years ago, Dr. A. H. Hughes, working in this Laboratory, found that ferric ions even in $N/100$ hydrochloric acid, would affect films of myristic acid both with respect to the state and phase boundary potential of the film; ferrous ions, on the other hand, in the same substrate at concentrations of 1.2 gm. ferrous sulphate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) per litre had no appreciable effect until oxidized by hydrogen peroxide. The ionic concentrations in these cases were of a different order of magnitude from those which we have considered above.

Similarly, in the case of stearic acid monolayers on $N/100$ hydrochloric acid, an increase of phase boundary potential of 55–60 millivolts is produced by the presence in the substrate of ferric ions in concentrations greater than $M/5000$. No changes were observed with copper, nickel, cobalt, chromic or ferrous ions, even in concentration of $M/300$ in the substrate. Monolayers of α -bromostearic acid on $N/100$ hydrochloric acid show an increase of phase boundary potential, and solidification, on addition to the substrate of ferrous ions in a concentration of $M/1000$, but only in the presence of hydrogen peroxide; $M/10,000$ solutions of lead acetate lower the phase boundary potentials of films of α -bromostearic acid by 30 millivolts.

In contrast to the case of stearic acid, films of α -bromostearic acid at pH 2 and pH 6 show no changes on addition of ferric ions to the substrate. While nickel and chromic ions produce an increase of phase boundary potential of films of α -hydroxystearic acid at pH 2, no changes are observed with these ions in the case of stearic acid and α -bromostearic acid. At pH 6, monolayers of ovalbumin show an increase of phase boundary potential on addition to the substrate of copper ions in concentration $M/3000$; nickel, ferric and uranyl salts are without effect even at much higher concentrations.

Since the chemical reactivities of the substances forming the films, as well as the physical characteristics of the films themselves, are so greatly affected by these metallic impurities, we have for the last few years made a practice of attempting to eliminate them by using glass or quartz troughs, employing a mica boom for the Langmuir balance and paying especial attention to the distilled water and the purity of the buffer salts. We may mention that we have not been uniformly successful in eliminating, on every occasion, all traces of metals which act as catalytic or photosensitizing agents, and believe that our experiments are especially affected by copper in so far as the activity is destroyed by the addition of potassium cyanide.

The profound modification of the chemical properties of the monolayers of widely different compounds

produced by the presence of extremely small traces of active substances including metallic ions is probably of great biological significance. The phenomena described are characterized by a sensitivity and specificity which is remarkably similar to that of many pharmacological actions. We wish to suggest that these methods may offer a means of approach, not only to the problem of the oligodynamic action of metals, but also to the elucidation of more general aspects of the action of drugs and the mechanism of photo-biological sensitization.

Colloid Science Laboratory,
Cambridge,
March 16.

J. S. MITCHELL.
E. K. RIDEAL.
J. H. SCHULMAN.

¹ NATURE, **139**, 367 (Feb. 27, 1937).

² Schulman, see Rideal, *Kolloid Z.*, **61** 218 (1932).

³ Rideal, *Proc. Roy. Soc., A*, **155**, 684 (1936).

⁴ Rideal and Mitchell, *Proc. Roy. Soc., A* (in the press).

IN a recent issue of NATURE, Myers and Harkins¹ directed attention to the possibility of considerable errors arising in experiments on monomolecular films where small quantities of ions are introduced from the glass vessel or the metal trough. Experiments which we have carried out recently at University College, London², show that corresponding errors may arise in the measurement of interfacial tensions as a result of the presence of minute quantities of ions in the distilled water. Thus when using ordinary laboratory distilled water, minima were obtained in the interfacial tension-concentration curves for sodium cetyl sulphate against various oils, the interfacial tension with 0.05 per cent sodium cetyl sulphate being several hundred per cent higher than the minimum which occurred at about 0.015 per cent. Similar results were obtained with sodium salts of other long-chain acids. On using very good conductivity water (specific conductivity 0.1×10^{-6} ohm⁻¹ cm⁻¹ or less) these minima were no longer found. The ordinary distilled water evidently contained small quantities of a cation which strongly depresses the interfacial tension of such systems, its effect being greater in the lower concentrations of long-chain salt.

The effect of salts in lowering the interfacial tension of oil against solutions of the salts of long-chain acids seems to depend primarily on the valency of the cation. Thus in a particular case (with 0.005 per cent $C_{17}H_{33}CON(CH_3)CH_2CH_2SO_3Na$) the concentration of salt required to diminish the interfacial tension from 6.25 to 1.0 dynes/cm. was 0.32 N sodium chloride, 0.003 N calcium chloride and 0.00005 N lanthanum chloride. The effect is independent of the nature of the anion, and is therefore analogous to the Schulze-Hardy rule for the precipitation of colloids. The influence of calcium salts has previously been observed by Harkins and Zollman with sodium palmitate³. In our experiments we have the same influence even when a long-chain acid with a soluble calcium salt is used.

On increasing the concentration of the salt the interfacial tension at first drops and then reaches a value which shows no further decrease. The higher the valency of the salt, the lower are these final values.

It would seem that the influence of the cation is in reducing the repulsion between the heads of the long-chain ions adsorbed at the interface, so allowing a closer packing in the interfacial film, with a consequent further lowering of the interfacial tension.

If our theory is correct, that the effect is primarily dependent on the valency of the ion with charge opposite to that of the long-chain ion, a corresponding effect, dependent on the valency of the *anion*, would be expected with such substances as cetyl pyridinium chloride adsorbed at the interface. Unfortunately, it was necessary to discontinue the research before this could be investigated.

CONMAR ROBINSON.

British Leather Manufacturers'
Research Association,
London,
March 14.

¹ Harkins and Myers, NATURE, **139**, 367 (Feb. 27, 1937).

² Robinson and Selby, unpublished.

³ Harkins and Zollman, *J. Amer. Chem. Soc.*, **48**, 69 (1926).

Acute Mercury Poisoning in a Respiration Chamber

IN the Laboratory of Zoophysiology we have a steel chamber of 27 cubic metres capacity, which is generally ventilated at a rate of 20 cub.m. per minute at pressures from the atmospheric down to 200 mm., corresponding to a height of 10 km.

In certain experiments it is used, however, without ventilation as a closed chamber in which the air is simply circulated, the oxygen supply being sufficient for two persons over twenty-four hours or more. In one such experiment, the effect of 4.5 per cent carbon dioxide had been studied over 19 hours without any symptoms beyond a pronounced hyperpnoea, but when it was desired to repeat this experiment and extend it over several days, the subjects became ill with bronchial irritation, violent coughing and severe headache after a few hours and had to break off.

In the night a few hours later, the condition became worse, with increased temperature, dyspnoea and nausea. After three days, a stomatitis affection supervened lasting two weeks, and the dyspnoea and fatigue by muscular exertion lasted for months.

Experimental animals (guinea pigs, rats and mice) were killed by the air in the chamber in 24-48 hours with severe pulmonary oedema.

A careful analysis showed that the symptoms were due to mercury poisoning from droplets spilled on the floor. Pulmonary symptoms became pronounced only when hyperpnoea was produced (by carbon dioxide), but in the absence of this the animals developed oedema and hæmorrhagia of the lower gut and died in three to four days instead of one to two days. When the air in the chamber was not artificially mixed, the animals would remain alive for several days more. Even when the chamber had been cleaned out and every visible trace of mercury removed, symptoms of mercury poisoning could still be produced in one to two weeks, and the last invisible traces had to be removed by long-continued ventilation.

It is evident that mercury in a non-ventilated or poorly ventilated room can become very dangerous, especially at high temperature, when the air is kept well mixed and when the subjects are breathing deeply, as with muscular work. It would appear that even in ordinary rooms in which mercury is spilled occasionally and can become finely divided and distributed by floor scrubbing, the air can become sufficiently poisonous to cause mild chronic symptoms

in persons spending much of their time in such rooms, and this note is published mainly to warn against such danger.

A full account of the experiments will be published in *Skand. Arch. Physiol.*

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March 5.

Ammonia Formation in Shed Blood and a Characteristic Deaminase of the Blood Stream

APPLYING a method¹ for determining the blood ammonia by which forty determinations may be easily carried out in a few hours on 1 ml. samples, certain curious facts have been discovered. As is well known, ammonia forms in shed and sterile blood, and it has been shown to begin from zero concentration¹. In a further study here, it has been observed that the formation goes in a succession of well-marked stages. Five such have been observed over the 24 hours. Such phasic formation has been observed for the rabbit, man and bird, appearing in the blood from each individual but at somewhat varying times, so that averaging the results from many animals will smooth out the curve of formation.

The following gives a summary of the phases as they appear in oxalated and sterile rabbit's blood (whole or laked) at room temperature.

	Duration (min.)	Conc. reached (γN%)
1st phase	0-5	50
2nd phase	5-45	200
3rd phase	45-100	400
4th phase	100-200	700
5th phase	240-400	1600

These figures are only very approximate, since occasional delays of upwards of an hour or more may occur before the appearance of a phase, the blood ammonia remaining constant the while. The optimum pH for the formation is about 8.7, though at 9.1 it is only a little less. The formation is also much influenced by saline concentration and practically ceases with 5 per cent sodium chloride. A reversal effect has been observed on the acid side and is being investigated.

During a study of the effect of adding a large number of different amino compounds to shed blood, a very potent deaminase of adenosine has been discovered therein. This would seem universally distributed, if we may judge from its appearance in the blood of man, fowl, frog and the lug worm (*Arenicola*). Its concentration in rabbit's blood is such that small quantities of adenosine added to shed blood (laked) are deaminated to within 60-90 per cent of the maximum in five minutes, the blood being maintained at pH 6.7 (most suitably by such a buffer as maleic acid owing to the specific action of the phosphate). This deamination rate occurs at room temperature and with a blood dilution of 1:3. The blood concentration of the enzyme is sufficiently high in the rabbit to suppose that all the adenosine deaminase previously found in muscle and liver^{2,3,4} may have been really contained in the residual blood in these tissues.

By comparison with adenosine, adenylic acid (from muscle) added to laked blood is practically untouched after several hours, unless buffered towards the acid side (maleic acid buffers) and even then very

much more slowly than adenosine. In fact, just as the adenylic acid deaminase may be described as the special deaminating ferment of muscle, so adenosine deaminase may be regarded as characteristic and apparently universal for the blood stream, and appears both in plasma and in red corpuscle.

It has also been shown here that the nucleated corpuscle of the fowl can deaminate adenine, guanine and cytosine readily at room temperature.

E. J. CONWAY.
R. COOKE.

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March 10.

¹ Conway, E. J., *Biochem. J.*, **29**, 2755 (1935).
² György, P., and Rothler, R., *Biochem. Z.*, **187**, 194 (1927).
³ Schmidt, G., *Z. physiol. Chem.*, **179**, 243 (1923).
⁴ Schmidt, G., *Z. physiol. Chem.*, **208**, 185 (1932).

A Simple Aromatic Oestrogenic Agent with an Activity of the Same Order as that of Oestrone

IT has previously been shown that the phenanthrene nucleus is not an essential part in the molecule of an oestrogenic substance¹, since the full oestrus response could be produced by the injection of substances so simple as 4:4'-dihydroxy diphenyl. Further experiments with compounds of this type have been made, and the following table indicates the potency of some new substances.

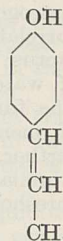
TABLE 1.

Substance	Dose in mgm.	Percentage positive
4:4'-Dihydroxy dibenzyl	100	100
4:4'-Dihydroxy stilbene	10	100
" " " " " " " " " " " "	5	60
4-Hydroxy stilbene	10	100
" " " " " " " " " " " "	5	40
Stilbene	25	100
4:4'-Dihydroxytolane	10	100
" " " " " " " " " " " "	5	80
4:4'-Dihydroxy diphenyl ether ..	100	100
4-Hydroxy-phenyl cyclohexane ..	100	80

In view of the activity of stilbene, it was decided to experiment with substances containing only one benzene ring, and it was found that so simple a compound as *p*-hydroxy phenyl ethyl alcohol was capable of producing a full oestrus response in 60 per cent of animals when injected in doses of 100 mgm.

A much more potent substance, however, was found to be the phenol derived from the essential oil anethole. This substance, namely, *p*-hydroxy propenyl benzene, or anol, was found to possess a very high degree of activity.

In each case the material was administered dissolved in 3 c.c. of sesame oil, and was given in six injections, morning and evening during three days. The rats were smeared on the morning of each day, and on the fourth and subsequent days were smeared at midday and in the evening in addition. *p*-Hydroxy propenyl benzene when administered in this manner was found to be active in doses from 100mgm. down to 0.001 mgm. Thus 1 γ is capable of producing a full oestrus response in 100 per cent of the animals injected. The amount of oestrone required to produce a similar response in these animals is in the region of 1 γ. It



can be seen, therefore, that this simple substance has an activity approaching that of the naturally occurring hormone, oestrone. It is also interesting to note that the benzoylated compound is active. (The benzoate of *p*-hydroxy propenyl benzene crystallizes from alcohol in plates, m.p. 124° C. and gave on analysis C = 80.4 per cent, H = 6.0 per cent; C₁₆H₁₄O₂ requires C = 80.6 per cent, H = 5.9 per cent.)

It is as yet too early to discuss the theoretical importance or therapeutic application of these observations, but the fact that the potency is so high brings a new importance to the investigation of synthetic oestrogenic agents.

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¹ Dodds and Lawson, *NATURE*, **137**, 996 (1936).

Cyclical Fluctuations in Oestrin Threshold

CYCLICAL changes in the accessory reproductive organs of female mammals have been ascribed entirely to cyclical fluctuations in the secretion and interaction of the ovarian hormones. Fluctuations in the latter are controlled by the anterior lobe of the pituitary.

Experiments in which oestrogenic hormone has been injected into the same female rhesus monkeys over a period of two years show that a new factor must be taken into account in the explanation of rhythmical changes in the accessory organs. It appears that the threshold of a monkey to oestrogenic stimulation varies cyclically. The least constant daily dose of oestrogenic hormone that is required to influence the uterus sufficiently for the cessation of injections to be followed by a phase of uterine bleeding, or that is necessary to maintain the uterus in a phase of growth, is not necessarily the same on different occasions. In one experiment, phases of uterine bleeding occurred at regular intervals of from five to seven weeks in a spayed immature monkey that was injected daily with 100 I.U. of oestrone for a period of a year. The rhythmical rise in the oestrone-threshold must be due either to the cyclical liberation into the blood stream of a substance (possibly from the pituitary) which in some way neutralized oestrone, or to an inherent cycle in the threshold of the tissues. It is of interest that these fluctuations were revealed not only by mature animals, but also by one that had not reached puberty at the time its ovaries were removed.

The pronounced mid-cycle fall in the degree of oestrogenic stimulation in the menstrual cycle is correlated with the removal of water from both the uterus¹ and the sexual skin² (a considerable amount of water may be removed from the sexual skin). The further dehydration of the uterus at the time of menstruation¹ is not improbably related to a further, but relative, fall in the degree of oestrogenic stimulation occasioned by a rise in the oestrone-threshold of the kind described above.

S. ZUCKERMAN.

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University Museum,
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March 21.

¹ van Dyke, H. B., and Chen, G., *Amer. J. Anat.*, **58**, 473 (1936).

² Krohn, P. L., and Zuckerman, S., *J. Physiol.*, **88**, 369 (1937).

Nicotinic Acid and the Growth of *Staph. aureus*

FURTHER chemical work towards the isolation of the so-called 'staphylococcus growth-factor', previously described¹, suggested that at least part of the biological activity of the high-vacuum distillate derived from yeast extract might be due to nicotinic acid and/or the corresponding amide.

The gelatin-hydrolysate basal medium already described¹ was used. *Staph. aureus* will not grow (aerobically) on this medium alone. It has now been found that addition of nicotinic acid, or its amide, will permit growth when added to this basal medium, as a substitute for the concentrated preparation from yeast (high-vacuum distillate) ordinarily used as source of the growth-factor. This distillate and nicotinic acid have the same order of activity.

The same potency is shown by different samples of nicotinic acid, namely: (a) nicotinic acid prepared by nitric acid oxidation of nicotine; (b) nicotinic acid prepared by acid hydrolysis of pyridine-3-nitrile (prepared from pyridine); (c) a three-times recrystallized specimen from a fractional crystallization of technical nicotinic acid (the least- and most-soluble fractions were somewhat less active).

The fact that the pyridine-3-nitrile was inactive before hydrolysis is the best evidence that it is nicotinic acid itself and not an associated impurity which is biologically active.

Nicotinic amide is more active than nicotinic acid; 0.05 γ of amide per 10 ml. of medium will permit a just visible growth.

Using the amino-acid basal medium recently described², nicotinic acid and the amide are inactive, whereas the high-vacuum distillate is active. This indicated therefore that the 'staphylococcus growth-factor' is complex, and that only one component of it can be replaced by nicotinic acid or its more active amide. The other component (or components) is present in limited amount in the gelatin-hydrolysate, and in the high-vacuum distillate.

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Bland-Sutton Institute of Pathology,
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London, W.1.
March 10.

¹ Knight, B. C. J. G., *Brit. J. Exp. Path.*, **16**, 315 (1935).

² Fildes, P., Richardson, G. M., Knight, B. C. J. G., and Gladstone G. P., *Brit. J. Exp. Path.*, **17**, 481 (1936).

Visible Mesomorphic Fibres of Tobacco Mosaic Virus in Juice from Diseased Plants

IN *NATURE* of December 19 last there appeared an interesting letter by Bawden, Pirie, Bernal and Fankuchen under the heading "Liquid Crystalline Substances from Virus-infected Plants". I have arrived at conclusions similar to some of those recorded in the above letter, and the following, to some extent complementary, observations may be of interest.

Fig. 1 (a) is a photomicrograph of what I consider to be fibres of tobacco mosaic virus. This conclusion is based on the following facts. The fibres developed in a sample of the expressed juice of mosaic-diseased tobacco plants which had been clarified by centrifuging and afterwards stored at about 1° C. for several months. The bulk of the juice was then found to be clear, and a dense, creamy-white, fibrous sediment of protein, which took up less than one-fifth of the total volume but which contained 97 per

cent of the infective principle, had formed at the bottom of the flask. A drop of this sediment with accompanying mother liquor was taken to prepare the slide used for the photographs reproduced here.

The fibres, when undisturbed, appeared to be several centimetres long and fairly flexible, but when mounted under a cover-slip they usually broke into fragments 2-5 mm. in length. The width of individual fibres was of the order of 0.001 mm. Viewed under crossed nicols, the fibres were seen to be doubly refractive with straight extinction, as shown in Fig. 1 (*b* and *c*).

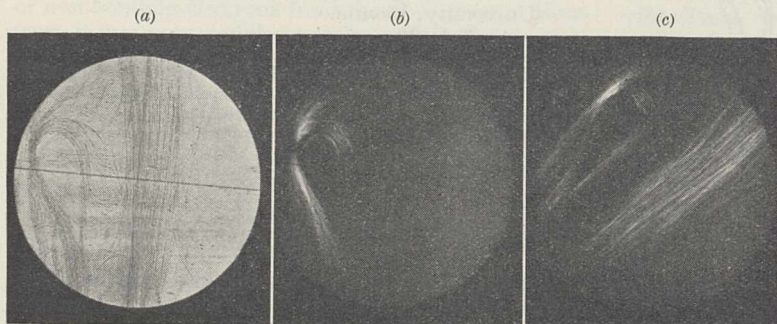


Fig. 1

a. PHOTOMICROGRAPH OF PORTION OF FIBRES FORMED IN THE CLARIFIED JUICE OF MOSAIC-DISEASED TOBACCO PLANTS AFTER THE JUICE HAD STOOD AT 1° C. FOR SEVERAL MONTHS. *b.* THE SAME FIELD AS IN *a*, PHOTOGRAPHED BETWEEN CROSSED NICOLS. *c.* THE SAME FIELD AS IN *a* AND *b* PHOTOGRAPHED BETWEEN CROSSED NICOLS AFTER ROTATING THE STAGE THROUGH 45°. ALL × APPROX. 60.

An entirely different property was observed when the fibres were viewed by reflected light. They showed up as bright white streaks when the incident light was at right-angles to their length, but were scarcely visible when the light was parallel to the fibres, suggesting a terraced structure in one direction.

By gently agitating the suspension, the fibres broke up into shorter lengths and had the appearance of short, straight needles or rods (0.1 mm. or shorter). Violent shaking reduced the greater part of them to a state where they were no longer visible (× 600), and at this stage the suspension was translucent. On standing undisturbed, the process was reversed, and finally the long, satin-like fibres reconstituted and settled at the bottom of the tube, leaving a clear, supernatant liquid. This process was repeated many times without causing any apparent change in properties. The fibres were reduced to a state below microscopic visibility by quite moderate dilution.

The probability of the identity of the fibres with the infective principle was further strengthened by their behaviour when heated. The fibrous material underwent no visible change until a temperature just below 92° C. was reached, when the whole mass cleared abruptly and the fibrous, satin-like substance changed to a clumped, coagulated mass which floated to the top. The fibres were then no longer visible under the microscope and the change appeared to be irreversible. The temperature at which the fibres collapsed is also the temperature of the thermal inactivation point of this virus.

If the reaction to heat of a dense, tangled mass of the fibres is watched under the microscope, the fibres are seen to maintain their form and appearance unchanged until near the transition point, when

there occurs a quivering of the whole mass, frequently followed by a general flow. The fibres then straighten and appear to become taut. This is followed by a back-and-forth movement, and suddenly the fibres break and each segment shrinks or telescopes in opposite directions. The disrupted fragments go on shrinking and collect in aggregates, leaving the formerly crowded field practically empty.

The ease with which the fibres break up on agitation, and re-form on standing to give exactly similar forms, and other properties, indicate a homogeneity of the constituent units. These fibres are not formed in the expressed juice of healthy plants which has been stored under the same conditions. Although this in itself by no means proves the virus nature of the fibres, when we consider the evidence as a whole, particularly the association of infectivity with the fibres and the identity of the temperature at which the fibres undergo a sudden, deep-seated and apparently irreversible change with the temperature at which the virus rapidly and irreversibly loses its infectivity, there can be little doubt that the fibres are composed of virus, or at least that the virus forms an essential constituent of the fibres. It seems to be a fair conclusion that these mesomorphic, flexible fibres consist of long chains of virus particles linked together by relatively feeble bonds.

The circumstance that under certain conditions the fibres have the appearance of short needles or rods raises the question as to whether the needles obtained by crystallization from ammonium sulphate solution, as first worked out by Stanley¹, may not in fact be short mesomorphic rods rather than true crystals.

The deduction by Bawden, Pirie, Bernal and Fankuchen of the presence of long fibres in their systems, is thus confirmed by my direct observation of the existence of such fibres.

RUPERT J. BEST.

Waite Agricultural Research Institute,
University,
Adelaide.
Jan 30.

¹ Stanley, W. M., *Phytopath.*, 26, 305 (1936).

Adsorption on Foam

SINCE surface active substances are among the most active pharmacologically (Michaelis and Rona¹) we may expect that surface active substances in the organism may be likewise of great importance. It occurred to me that the adsorptive capacity of the great surfaces of foams might be employed in the concentration of such substances, and I have developed a simple technique for this purpose.

The apparatus² is outlined in Fig. 1. The liquid to be examined is placed in *C*. Air or an inert gas is bubbled through the liquid by means of the capillary tube *A* which ends in a fine jet *B*. The tube *A* is sealed into the ground glass junction *E*, and may be interchanged with other tubes having various bores. The gas pressure is adjusted so that the foam produced by the bubbles passes slowly over into the a receiver *D*. *C* and *D* are connected by a ground glass

junction *G* which allows the interchange of receivers, so that *different fractions of the foam* may be removed. The liquid formed in *D* (denoted by *F*) by the settling of the foam, may now be compared with the original solution (denoted by *O*), and the remainder of the solution in *C* (denoted by *R*). In an experiment with saponin, 1 ml. of the solution *F* was calculated to have had a total superficial area of about 32 m.² when in the foam state, which area corresponds to the thickness indicated by the appearance of interference colours.

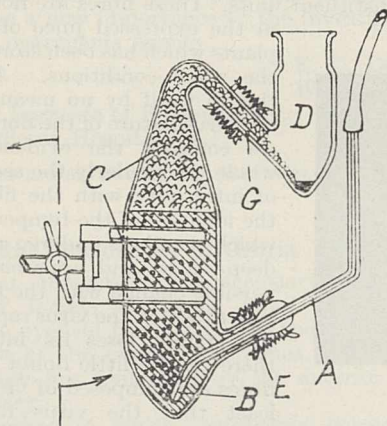


Fig. 1.

The surface tension of the solutions always shows the following relationship: $R > O > F$. By experiments on sodium cholate, carried out in collaboration with R. Bader, it has been shown that there is a concentration of the cholic acid (furfural-test, Pulfrich photometry³) in the liquid formed from the foam (*F*), which contains up to 65 per cent more of the acid than *O*. Further, it proved possible to separate cholic acid from Na-cholate by this method. A precipitate always formed in the earlier *F*-fractions, which proved to be pure cholic acid. No precipitate ever formed in *O* or in *R*.

In most cases the *pH* of *F* and *R* was different from the *pH* of *O*. For example, when *O* is rabbit serum or Na-cholate, *F* tends to become acid, *R* to become alkaline. When *O* is saponin the change in *pH* is in the opposite direction. This apparently means that all the ions are not equally adsorbed on the foam surface. In the case of 0.5 per cent Na-cholate solution, the difference in surface tension (σ) between the *F* and the *R* is about 6–8 dynes/cm., the difference in *pH* is about one unit. In the case of 0.02 per cent saponin solution $\Delta\sigma$ is up to 20 dyne/cm., ΔpH about 0.6 unit. Measurements of *pH* were made with a glass electrode, surface tension by the ring method (Lecomte du Noüy's automatic tensiometer⁴).

In collaboration with H. Mann it was further found that the foam has a higher temperature than the liquid from which it is produced (when the gas has the same temperature as the liquid). This effect seems to be a necessary condition for the formation of any foam. The effect would appear to agree with the principle of Braun and Le Chatelier, since in the case of all the substances examined, the production of foam becomes more difficult as temperature increases. The temperature difference (ΔT) between foam and liquid is greater for low concentrations of capillary active substances than for high concentrations. In the case of 0.01 per cent saponin solution, $\Delta T = 3.3^\circ \text{C}$.

In collaboration with G. Kolmer it was found that haemoglobin is less concentrated in the first fractions of *F* than in *O*, but more concentrated in later fractions of *F*, when *O* is a mixture of haemoglobin and serum. It would seem that substances differing from each other as regards capillary activity pass over one after the other in the various fractions. In collaboration with H. Lassner it was found that the complement and antibodies (haemolysines) of rabbit serum are not destroyed in the foam.

Detailed reports will appear shortly.

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Institute of Physiology,
University, Vienna.
Feb. 23.

¹ Michaelis und Rona, "Prakt. d. physikal. Chemie" (Berlin, 1930).

² Pat. pending. The apparatus is obtainable of K. Ewald, Vienna IX.

³ Josephson, B., *Biochem. J.*, **29**, 1519 (1935).

⁴ Lecomte du Noüy, "Equilibres superficiels des solutions colloïdales" (Paris, 1929).

Absorption Spectrum of the Carboxyl Group in the Vacuum Ultra-Violet

WE have recently been investigating the far ultra-violet absorption spectra of a number of organic compounds of the type $R_1\text{COOR}_2$; *R* being an alkyl group or a hydrogen atom. It has been found that only the simplest of these, namely formic acid, shows discrete absorption bands in the region 2000–1000 Å. The interpretation of the electronic structure of the carboxyl group will therefore depend to a considerable extent upon the analysis of these discrete bands.

The first strong absorption of formic acid starts around 1550 Å., at which wave-length a set of somewhat diffuse bands appear. Between 1400 Å. and 1100 Å. the bands are sharp. The analysis shows that they consist of a number of electronic transitions each of which is represented by a short vibrational progression of two or three members. These progressions are strong and well separated at long wave-lengths, but become weaker and overlap towards shorter wave-lengths, eventually merging into a continuum around 1100 Å. A plausible Rydberg series formed from the ν_0 's of the progressions has its limit just about where the continuous absorption begins, namely, 11.2 volts. This value may be compared with the value 10.83 volts obtained for the ionization potential of formaldehyde by a similar method¹.

Mulliken² has shown that the latter ionization potential is to be associated with the removal of a non-bonding $2p$ electron from the oxygen atom of the $\text{C}=\text{O}$ group. He also states that the absorption spectra of the organic acids and esters should resemble the aldehydes and ketones in this respect. The closeness of the two ionization potentials seems to confirm his view. In fact, below 1600 Å. a definite correspondence has been found between the electronic transitions of formaldehyde and formic acid; the related bands of both molecules occurring in the same wave-length regions. While there are no analogues in the spectrum of formic acid to the formaldehyde bands at 3000 Å. and 1750 Å., it must be pointed out that these latter bands are not included among the Rydberg bands of that molecule. Actually their upper states have been assigned to certain anti-bonding orbitals which are apparently suppressed by the presence of the $\text{O}-\text{H}$ group.

Further evidence that the ionization potential reported here is to be attributed to an electron from

the carbonyl group comes from the fact that the strongest vibration frequencies accompanying the excitation were found to have values lying between 1400 and 1500 cm^{-1} . A consideration of the intensity distribution in the progressions shows that they correspond to the vibration 1647 cm^{-1} , of the unexcited state². This is the valence frequency of the C=O bond. Thus we have both the vibration and the excitation occurring in the carbonyl group.

In addition to the bands reported above, some very diffuse (pre-ionized) bands were found in the region below 1100 Å, superimposed on the ionization continuum. These may well be due to the excitation of non-bonding electrons from the O-H group. However, it was not possible to make sufficiently accurate measurements on them to justify an analysis.

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¹ Price, W. C., *J. Chem. Phys.*, **3**, 256 (1935).

² Mulliken, R. S., *J. Chem. Phys.*, **3**, 564 (1935).

³ Hibben, J. H., *Chem. Rev.*, **18**, 1 (1936).

A Sensitive Adaptation of the Spoon Gauge

THE spoon gauge is probably the most satisfactory and easily constructed instrument available for the accurate measurement of pressure differences when the use of a manometric liquid is not permissible. Its sensitivity, however, is limited to a pointer movement of about one millimetre for each millimetre of mercury pressure, or perhaps a little more with very fragile gauges. We describe below an effective design which shifts the sensitivity several decimal places into the high vacuum range.

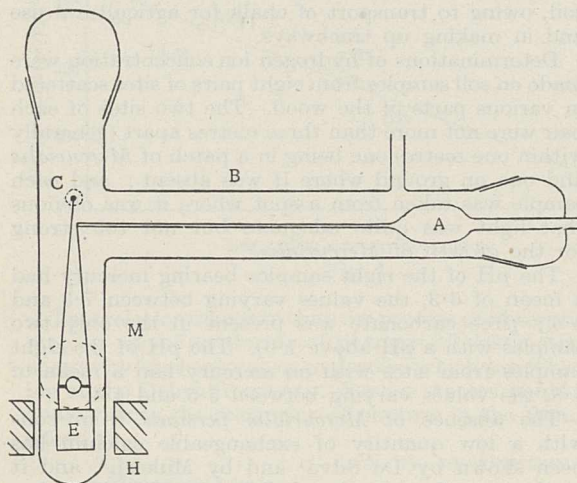


Fig. 1.

The essential feature of the device is a special form of bifilar suspension, which permits amplification of the movement of the pointer end. This suspension consists of unequal and non-parallel threads, the supports of which, placed one above the other, can be brought as closely as desired to the same vertical line. One support is the pointer end, and the other is a movable arm controlling the sensitivity. The threads, spreading out downwards, so as to clear the lower obstructing arm, carry on their ends a

horizontal beam to which is attached a mirror and damping device.

The sensitivity depends on the effective horizontal separation of these supports, and this distance can be reduced to less than the thread diameter. Using comparatively rough methods and the usual mirror and scale distances, a magnified movement of about ten thousand-fold is obtainable. With refined methods this figure could be considerably improved.

The particular gauge described below, although simple and convenient in construction, had a sensitivity exceeding one ten thousandth of a millimetre of mercury, and was almost entirely free from vibrational disturbances. A large vertical tube *M* in Fig. 1, housing the suspension, carries two horizontal tubes at right angles, the lower one *B* containing the 20 cm. spoon gauge *A*, and the upper one *C* ending in a ground joint. In this joint could be rotated a slightly eccentric glass arm ending above the tip of the gauge pointer. Long fibres of silk are first attached to the suspension unit, which is lowered into the tube *M*. With each thread touching a support, the beam is adjusted to oscillate axially in the tube about a line parallel with the gauge pointer. The fibres are then sealed to the respective supports with apeison wax and the upper superfluous portions cut short with a hot wire. The sensitivity is raised by rotating sufficiently the cranked rod, and finally all joints are sealed with apeison wax.

The suspension unit consists of a light glass beam, carrying a galvanometer mirror facing a window, and below is fixed a light cylinder of aluminium foil *E*. This rotates in the field of the electromagnet *H*. With critical damping a pressure change is registered with the required accuracy in about two seconds—the natural period of the suspension. The spot light remains stationary within half a millimetre even with the thermostat stirrer running vigorously.

It was found that the zero reading varied somewhat with the magnetic field, due presumably to the magnetic properties of the aluminium vane. For critical damping this amounted to sixty millimetres, and care was taken to maintain a constant field.

This spoon gauge had normally a sensitivity of 8 mm. movement of pointer tip for a pressure change of 10 mm. of mercury. When erected with the scale at two metres from the mirror, the gauge had a sensitivity of 1 mm. deflection for 4×10^{-5} mm. of mercury pressure. This indicated a horizontal separation of the points of suspension of 0.13 mm., which distance is about the minimum that can be easily obtained with the simple arrangement described.

This principle may be used to magnify any horizontal movement.

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Molecular, Nematic and Crystal States of 1:1'-Diethyl- ψ -Cyanine Chloride

ATTENTION has been directed in NATURE¹ to a recent publication by Scheibe, Kandler and Ecker² concerning the narrow absorption and fluorescence band exhibited by certain solutions of the dye 1:1'-diethyl- ψ -cyanine* chloride, in which these authors, on the basis of viscosity measurements,

* This dye is termed 1:1'-diethyl- ψ -isocyanine in the German publication.

express the view that the effect is due to a reversible polymerization of ions of the dye. Since the publication of a previous note³, in which I have suggested that the narrow absorption band is characteristic of the molecular state, the ageing of aqueous solutions of 1:1'-diethyl- ψ -cyanine chloride containing various concentrations of sodium chloride has been studied by the concurrent application of spectrographic, ultra-microscopic and streaming birefringence methods.

Four distinct phases have now been recognized.

1st Phase. Dye in true solution.

2nd Phase. Absorption spectrum changes from that of cationic dye to give a very sharp 'molecular' band at 573-574 m μ ; very strong fluorescence; uniform luminescence without structure seen with ultra-microscope; no streaming birefringence. This phase is rapidly succeeded by the

3rd Phase. The 'molecular' absorption band at 574 m μ shifts towards the red, and becomes less sharp as the preparation ages; fluorescence progressively weakens, and, when excited by plane-polarized light shows partial polarization, whereas the fluorescence similarly excited during the second phase is not polarized; the ultra-microscope shows a fine thread-like structure of a brilliant greenish yellow colour. The threads grow in thickness from about 5 m μ to 500 m μ , while streaming birefringence rapidly increases. This phase also shows powerful streaming dichroism.

4th Phase. After some weeks, normal prismatic crystals of the dye are formed.

Crystals of the dye, less than 1 μ thick, exhibit the following trichroism:

Vibrations to	Colour	Absorption	Surface Colour
$X = n_a$ for red $Y = n_b$	Pale yellow Bluish pink	General in blue Sharp maximum at 579 m μ	Pale violet Intense yellow
$Z = n_c$ for red	Dark brownish red	General from yellow to blue	Bluish violet

The crystals occasionally form slender needles by elongation along Y , and consequently appear bluish pink for vibrations along their length, and any shade from very pale yellow to dark brownish red for vibrations at right angles, according to their orientation. The crystals are not fluorescent.

The optical properties of the threads of the third phase differ in four respects from those of the needle crystals.

(1) The threads are strongly fluorescent, the fluorescence being plane-polarized with vibrations in the length of the thread.

(2) The absorption of light vibrating parallel to the length of the thread at first shows a very sharp maximum at 573 m μ , which flattens and moves towards the red as the preparation ages, ultimately becoming identical with that of the Y direction of crystals. The threads appear bluish pink for this vibration direction.

(3) The absorption of light vibrating perpendicular to the length is independent of the orientation of the threads, which appear pale orange for such vibrations.

(4) The birefringence is of the same sign for all orientations of the threads, so that the birefringence of threads crossing at a very acute angle is always additive, whereas with random orientations of needle crystals crossing at an acute angle, partial or complete neutralization often occurs.

The threads appear to be true crystals in one dimension (Y) only, for the abnormalities 3 and 4 above are accounted for if we assume that the molecules have either free rotation, or else a random orientation, about the Y axis. It is therefore highly probable that the threads of Phase 3 are strictly analogous to the nematic form of 'liquid crystal'. The viscosity abnormalities noted by Scheibe, Kandler and Ecker are therefore explained, not by "polymerization of dye ions" but by the existence of nematic aggregates of dye molecules. The sharp absorption band and associated fluorescence is a characteristic of electronic transitions of individual molecules and their nematic aggregates.

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March 11.

¹ "Research Items", NATURE, 139, 378 (1937).

² Scheibe, Kandler and Ecker, Naturwiss., 25, 75 (1937).

³ Jelley, E. E., NATURE, 138, 1009 (1936).

Precise Distribution of *Mercurialis perennis* according to Soil Hydrogen Ion Concentration

IN a wood covering several acres on the Lower Greensand of Surrey, *Mercurialis perennis* (dog's mercury) appeared to be distributed in an irregular way, in patches which clearly were not determined by the light intensity alone. In one case it was abundant along the lower side and absent along the upper side of a track that ran across a gentle slope. The pathway had been made up with chalk, and it was clear that the sandy soil below the path had become a possible habitat for *Mercurialis* because of the washing down of solid calcium carbonate and probably of dissolved bicarbonate as well. The whole region covered by the wood bears scattered patches of chalky soil, owing to transport of chalk for agricultural use and in making up trackways.

Determinations of hydrogen ion concentration were made on soil samples from eight pairs of sites scattered in various parts of the wood. The two sites of each pair were not more than three metres apart (generally within one metre) one being in a patch of *Mercurialis* and one on ground where it was absent; and each sample was taken from a spot where it was obvious that light was quite adequate but not too strong for the growth of *Mercurialis*.

The pH of the eight samples bearing mercury had a mean of 6.3, the values varying between 7.3 and 5.5; (free carbonate was present in the only two samples with a pH above 7.0). The pH of the eight samples from sites with no mercury had a mean of 4.8, the values varying between 5.5 and 4.4.

The absence of *Mercurialis perennis* from soils with a low quantity of exchangeable calcium has been shown by De Silva¹ and by Mukerji², and it needs no substantiation. Likewise De Silva has reported the local occurrence of *Mercurialis* on a spot which had recently been given a higher base status by the dumping of rubbish. What is interesting about the records given here is not so much that the spots bearing *Mercurialis* have a high pH, as that the similar spots tested where there was no *Mercurialis* all showed a distinctly lower pH, that is, that *Mercurialis* has become distributed to all (generalizing from the data collected) the adequately lit spots where the edaphic factors make its growth possible. This is, of course, a state of affairs which one would expect, particularly in a species readily dispersed and

not hampered by an already closed community, and its truth is generally assumed; but as one rarely sees data which prove the point, it seems of interest to recount the facts given above, which serve as a proof for this particular case and within the limits of the rough method adopted.

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Feb. 24.

¹ De Silva, B. L. T., *J. Ecol.*, **22**, 532 (1934).

² Mukerji, S. K., *J. Ecol.*, **24**, 317 (1936).

Absorption of Strain Energy in Metals

WHEN a metal is strained, the work done is partly stored up as strain energy and partly used up by internal absorption. The ratio (ϕ) of the energy absorbed to the energy stored is a constant, characteristic of the material, but sensitive to changes in structure and temperature. It is often assumed that the absorption can be represented by a damping force proportional to the velocity of deformation, but such an assumption is not in agreement with the experimental facts.¹

There appears, however, to be a linear relation between the Debye temperature θ of a metal and the logarithm of ϕ . This is shown by the graph below in which the values for Debye temperatures (calculated from specific heats) have been taken from the "Handbuch der Metall-Physik", vol. 1, p. 252 (Leipzig, 1935), and the values of ϕ from a paper by A. L. Kimball and D. E. Lovell². It should be noted that apparently Kimball and Lovell took no special precautions to ensure constancy of temperature.

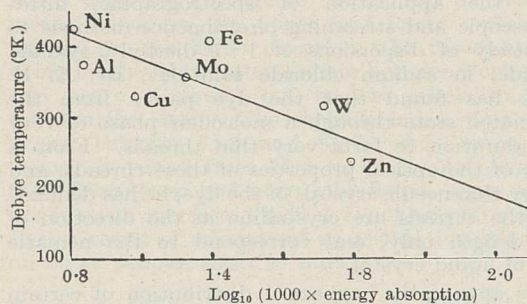


Fig. 1.

This relation suggests that the process of absorption may be one of scattering of phonons of elastic strain energy by those atoms or molecules which are vibrating at the Debye frequency. Such a process would be analogous to the scattering of photons in the Raman effect.

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¹ de Bruyne N. A., and Maas, J. N., *Aircraft Engineering*, 1936, p. 289.

² *Mechanical Engineering*, 1927, p. 440.

Electrical Stimulation of the Cochlea

IF the external auditory meatus is filled with saline solution and an alternating current is passed through the ear by means of an electrode immersed in it, a tone is heard. The pitch is determined by the frequency of the alternating current and may correspond to its fundamental or first harmonic^{1,2,3,4,5,6}.

If at the same time the stem of a vibrating tuning-fork is placed on the head, it is easy to obtain regular beats by adjustment of the a.c. frequency. This shows that the 'electric' stimulus and the bone-conducted stimulus travel along a common pathway before they enter any all-or-none-mechanism. As v. Békésy⁷ has shown the same regarding air conduction and bone-conduction, it is clear that in electrical stimulation of the cochlea the same peripheral mechanism is involved as in stimulation by air-borne sounds.

This seems to give further support for the 'movement' theory advocated by Stevens⁵ and by Hallpike and Hartridge⁶—but only if one assumes that pitch-discrimination in normal hearing is effected by mechanical resonance (which, incidentally, is my belief). It may, however, be pointed out that even if pitch-discrimination were effected by electrical resonance *ad modum* Zotterman³, one should expect the transient effects described by Hallpike, Hartridge and Rawdon-Smith⁸. As is well known, the behaviour to transients of a resonator of given pitch and selectivity is the same, whether it is constructed from electrical or mechanical components.

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¹ Jellinek and Scheiber, *Wien. klin. Woch.*, **43**, 417 (1930).

² Perwitzschky, *Z. Hals usw. Heilk.*, **26**, 477 (1930).

³ Fromm, Nylén and Zotterman, *Acta Otolaryngol.*, **22**, 477 (1935).

⁴ Gersuni and Volokhov, *J. Exper. Psychol.*, **19**, 370 (1936).

⁵ Stevens, *J. Acous. Soc. Amer.*, **8**, 191 (1937).

⁶ Hallpike and Hartridge, *NATURE*, **139**, 192 (1937).

⁷ v. Békésy, *Ann. der Phys.*, (5), **13**, 111 (1932).

⁸ Hallpike, Hartridge and Rawdon-Smith, *NATURE*, **138**, 839 (1936).

Diurnal Variation of Cosmic Ray Shower

WITH a three-fold coincidence apparatus, counters arranged in a triangle and with a lead plate 1.5 cm. thick placed above the upper counter, I have registered the intensity of a cosmic ray shower during a period of 110 days. The result of these measurements, performed at sea-level, does not show any connexion between the variation of the shower-intensity and the diurnal periodicity of the horizontal intensity of the earth's magnetic field, as is the case with vertical coincidences¹.

Assuming that a primary shower produces radiation composed of electrically charged particles, we should expect under the influence of the earth's magnetic field a much larger diurnal variation, for the greater barometer effect of the shower seems to suggest that the shower-producing primary radiation is softer than the radiation producing the vertical coincidences. The non-existence of any correlation between shower intensity and the earth's magnetic field can likewise be interpreted in the sense that the primary shower-producing radiation is not composed of electrically charged particles. On the other hand, the experiments indicate a very good agreement between the variation of the shower intensity and that of the temperature of the outer air; both having a maximum in the late afternoon. (Pribsch found at 2,300 m. altitude the maximum of the daily period to be at noon².) The positive correlation coefficient between shower intensity and temperature was found to be $r = 0.72 \pm 0.10$, and the temperature effect $TE = 0.074 \pm 0.010$ per cent per degree C.

The measurements were performed through the kind assistance of the Hungarian Council for Natural Science.

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March 13.

¹ Barnóthy, J., and Forró, M., *Z. Phys.*, **104**, 534 (1937).

² Priebisch, J., *Wiener Ber.*, **145**, 101 (1936).

Potential Constants of Tetrachlorethylene

IN my recent letter to NATURE on this subject¹, the values of f and γ which I have deduced from Delfosse's theory are erroneous. They should be re-

placed by the following: $f = 4.48 \times 10^5$ dynes/cm.; $\gamma = 0.65 \times 10^5$ dynes/cm.

It should be noted that f is greater than γ , which is in accord with ordinary chemical conceptions.

Finally, the values of ν_4 and ν_8 and of ν_4^* and ν_8^* should be interchanged.

These values will then read as follows:

$$\begin{aligned}\nu_4 &= 236 \text{ cm.}^{-1}; & \nu_8 &= 1569 \text{ cm.}^{-1}. \\ \nu_4^* &= 230 \text{ cm.}^{-1}; & \nu_8^* &= 1569 \text{ cm.}^{-1}.\end{aligned}$$

The conclusions reached in the letter are, however, unchanged.

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¹ NATURE, **139**, 288 (1937).

Points from Foregoing Letters

Commenting on the effects, observed by Harkins and Myers, of minute traces of metallic ions upon monomolecular films, Dr. J. S. Mitchell, Prof. E. K. Rideal and Dr. J. H. Schulman point out that minor traces of metallic ions 'sensitize' chemical processes in monolayers and affect the electrical potential at phase boundaries. This fact may be related to the biological action of the metals. Dr. C. Robinson describes the lowering of the interfacial tension between oil and water, in presence of salts of long-chain acids, due to calcium ions present as impurities in distilled water.

H. Christensen, M. Krogh and M. Nielsen suggest that symptoms of mercury poisoning may result from the presence of mercury spilled on the floor in poorly ventilated rooms.

The formation of ammonia in a series of stages, in shed blood, is described by Prof. E. J. Conway and R. Cooke. The authors also find that the blood (both plasma and red corpuscles) contains a powerful enzyme capable of splitting off ammonia from adenosine.

A plant derived from the essential oil of anethole (*p*-hydroxy propenyl benzene) is found by Prof. E. C. Dodds and W. Lawson to possess an oestrogenic activity approaching that of the sex hormone oestrone. The authors give a table showing the activity of several other compounds, proving that the phenanthrene nucleus is not an essential part in the molecule of an oestrogenic substance.

B. C. J. G. Knight reports that one of the 'growth factors' present in the high-vacuum distillate of yeast, which enables *Staphylococcus aureus* to be grown on a special 'basal medium', can be replaced by nicotinic acid or its amide.

The formation of visible mesomorphic fibres in clarified, expressed juice of mosaic-diseased tobacco plants is reported by R. J. Best. The fact that infectivity is associated with the fibres, together with the fact that the fibres collapse at the temperature of the thermal inactivation point of the virus, and other properties, lead to the conclusion that the fibres are the virus, or at least that the virus forms an essential constituent of the fibres. It is considered that the fibres consist of long chains of virus particles linked together by relatively feeble bonds.

A technique for the concentration of capillary active substances from composite liquids by the

use of foam is described by Dr. Franz Schütz. A difference in the degree of adsorption of certain ions on foam is shown to take place and with it a change of *pH* and surface tension in the liquid formed by the settling of the foam and in the original solution. Other phenomena, including a new physical temperature effect in connexion with foam, are discussed.

A device for increasing the sensitivity of the 'spoon gauge' for measuring pressure differences, the essential feature of which is a special form of bifilar suspension, is described by A. Lewis and Dr. D. W. G. Style. This enables a pressure difference 4×10^{-5} mm. of Hg. to be read on the scale.

By the application of spectrographic, ultra-microscopic and streaming birefringence methods to the study of dispersions of 1:1'-diethyl- ψ -cyanine chloride, in sodium chloride solutions, Dr. E. E. Jelley has found that the dye passes from the dissociated state through a molecular phase of very brief duration to form very thin threads. From a study of the optical properties of these threads, and of very thin needle crystals of the dye, he has deduced that the threads are crystalline in the direction of their length only, and correspond to the nematic type of liquid crystal.

The apparently haphazard distribution of certain plant species over a small area may really reflect very exactly the variations in the conditions of the habitat. This was observed by J. F. Hope Simpson to be the case with *Mercurialis perennis* (dog's mercury) in a wood the soil of which showed marked variations in hydrogen ion concentration.

An experiment showing that the stimulus produced by an alternating current in a saline-filled ear can be combined with that produced by a vibrating tuning fork to give 'beats', is described by E. Bárány. This, the author states, shows that the electric stimulus and the bone-conducted stimulus travel along a common pathway before they enter any all-or-none-mechanism.

Unlike the intensity of cosmic rays themselves, the number and intensity of showers produced by the cosmic rays at different times of the day is not related to the intensity of the horizontal component of the earth's magnetic field. This, Dr. M. Forró states, may indicate that the primary shower producing radiation is not composed of electrically charged particles.

Research Items

Racial Crosses in Cape Verde Islands

PROF. A. A. MENDES-CORREIA, director of the Institute of Anthropology, Oporto, took advantage of the presence of some three hundred natives of the Portuguese Colonies at the Colonial Exhibition at Oporto in 1934 to make a series of observations of their anthropological characters. Among them were nineteen cross-breeds from the Cape Verde Islands, of whom all with the exception of two were more than twenty years of age. Thirteen were male and six female. As the people of these islands have been little studied, the results (*Z. Rassenkunde*, 5, 1) are of no little interest. The population of the islands is 150,553, of whom 5,794 are white, 40,154 black, and 104,605 mixed. The subjects observed had dark brown skin, dark eyes and dark brown ulotrichous hair. One woman and two men showed wavy hair. The prominence of the cheek bones was marked in the majority of men and most women. The face was very variable. Three men and one woman showed a certain obliquity of the eyes. The nose was straight in profile, and was not long. The nostrils were elliptical, almost round, with the longer axis transversal. Only four men had a stature over 1.650 m. The number is too small for the mean of 1.702 m. to have significance. The female stature varied from 1.520 to 1.680 m. There appeared to be a tendency to exceed the Portuguese mean. The skelic index also appeared to approach the negro, rather than the Portuguese. A number of measurements taken on the upper and lower extremities pointed in the same direction, the measurements being on the whole intermediate between Portuguese and negro (Guinea), but on the whole inclining towards the latter. The cephalic index of the men varied between 74.4 and 84.1, while among the women it varied from 71.4 to 84.2. As compared with Portuguese and negro, the figures show a tendency to an increase, which it is not easy to explain. Is it a result of admixture, as certain investigations on other peoples seem to show?

Beavers in Michigan

DURING the open season of 1936 (March 16-31 in Lower Peninsula and April 1-15 in Upper Peninsula) 137 bodies of beavers (*Castor canadensis michiganensis*) trapped in Michigan were examined by Seth B. Benson (*Occas. Papers Mus. Zoo. Univ. Michigan*, No. 335, June 1936). Contrary to the opinion of trappers that males largely predominate among beavers trapped in spring, it was found that the sex ratios were practically equal, 51.8 per cent females, 48.2 per cent males. Measurements and weights showed that the animals fell into two groups, a yearling class, and two-year-olds with adults. The yearlings formed 59.1 per cent of the catch, 25 per cent were two-year-olds, and the remaining 15 per cent were three-year-olds or older. None of the yearling females was pregnant, and the appearance of the uteri suggested that they do not breed. There was some indication also that some two-year-olds do not breed, or, if they do, that it is later in the season than March and April. Of the 34 adult females, 21 or 61.7 per cent contained embryos, some being almost

full term. Although the author does not allude to the fact, it seems unfortunate that the open season should coincide with a period when so many females are about to produce young.

Biology of Arctic Marine Invertebrates

It has long been known that reproduction by direct development is a characteristic feature of bottom invertebrates in arctic seas. A recent publication by Gunnar Thorson has shown how prevalent this is ("The Larval Development, Growth, and Metabolism of Arctic Marine Bottom Invertebrates", *Meddelelser om Gronland*, 100, No. 6; 1936). A study of the bottom fauna and the plankton was made throughout the complete year in fiords in north-east Greenland. In all, about two hundred species of polychaetes, echinoderms, molluscs and crustaceans were studied. Of these, it was found that ninety-five per cent reproduced without true pelagic larval stages, the majority having very large yolky eggs. These were all purely arctic species, and the remaining five per cent, which had pelagic larval stages, were species not confined to the Arctic; these occurred in the plankton during the short period when food was most available. It is noteworthy that in north-east Greenland it was these latter species which were quantitatively commonest in the area. Examination of oxygen consumption was made, mostly on lamellibranchs, and it was found that they had a fairly high oxygen consumption compared with more southerly species at the same temperature. But at the temperatures at which they live respectively, the arctic species had a somewhat lower consumption than the southern. A comparison is made between the biology of the arctic fauna and those from other regions, and the origin of the arctic shore fauna is discussed. The paper is an important contribution to our knowledge of the biology of arctic marine animals.

Cirripedia of the Arabian Sea

A LARGE number of cirripedes are described by Mr. H. G. Stubbings (Cirripedia. The John Murray Expedition 1933-34. Scientific Reports. Vol. 4, No. 1. British Museum (Natural History), 1936). Two areas, the Zanzibar area and the Gulf of Aden, stand out as being specially favourable, twenty species out of forty-three collected by the expedition coming from the first, and thirteen from the second, only two species being common to both. Farther north along the South Arabian coast cirripedes were much scarcer. As is to be expected in such a deep sea collection, the genus *Scalpellum* and its subgenera predominate, fourteen species being represented. The geographical and bathymetrical distribution of *Scalpellum* is discussed, and it is shown that *S. velutinum*, which has a very wide distribution, ranges from 50 metres to 2,900 metres, but lives mainly between 600 metres and 2,000 metres. Several dwarf males were found on this species and a series of growth forms from newly metamorphosed cypris stages together with the cypris stages themselves. Dwarf males and growth stages were also found in various other forms. Among the specially interesting species are *Oxyngaspis*

aurivillii overgrown with polyps of an antipatharian, and several species growing on Crustacea. Amongst the latter are three species of *Pacilasma* all growing on the crab *Echinoplax pungens* which is a favourite host, and one of these also growing on the palinurid *Puerulus angulatus* from the Gulf of Aden. Five new species are described, three *Verruca* and two *Balanus*.

Use of the Developing Egg in Virus Research

VIRUSES are unable to multiply apart from living cells, and the maintenance of a virus in the laboratory after isolation has, therefore, depended upon inoculation for the most part, though tissue-culture methods, particularly those devised by H. B. and M. C. Maitland, have proved useful, but have replaced the living animal only to a limited extent. During the last four or five years, it has been shown that the chorio-allantoic membrane of the developing hen's egg is suitable for the cultivation of most, if not all, viruses, and solves many of the difficulties connected with their study. This work has been especially pursued by Dr. F. M. Burnet, who has now written a monograph on the subject (Medical Research Council, Special Rep. Series, No. 220. London: H.M. Stationery Office, 1936. 1s. net). This gives the full technique of the method, which is comparatively simple, surveys the published work on the subject, and contains many new observations and suggestions. It is surprising how many viruses can be cultivated by the method; by serial passage, it has even been possible to adapt the virus of epidemic influenza to the egg-membrane, which seems to constitute an ideal medium for virus study, as well as being cheap and requiring a minimum of attention. The chorio-allantoic membrane also provides a tissue of simple structure in which to study the histological changes that may be caused by a virus infection.

Fire Blight of Apples and Pears

THE bacterial disease caused by *Erwinia amylovora*, and known as fire blight, has been a serious menace to apple and pear trees in America for more than half a century. Many studies of the disease and the pathogen have been made, and a recent publication by Dr. K. G. Parker (Cornell Univ. Agr. Exp. Sta. Mem. 193, August 1936, Ithaca, N.Y.) describes further investigations upon the overwintering, dissemination and control of the malady. Large cankers appear upon the branches of infected trees, or are brought to the orchard upon grafting material. The activity of the bacteria within such cankers causes an ooze of infectious material, which may be disseminated to healthy shoots by rain or by insects. Several species of flies, and ants, stand incriminated in this respect. A few bacterial organisms which are antagonistic to *E. amylovora* have been found, and some of them can inhibit the infection of blossoms when inoculated along with the pathogen. Disinfection of the overwintering cankers seems to be the obvious method of control, and solutions of cadmium sulphate have been found most suitable for this purpose.

Refrigerated Gas-Storage of Fruit

SINCE 1929, the capacity of gas stores in England has risen from negligible proportions to more than two million cubic feet in 1936—a capacity not far short of a million bushels of apples. The time is

thus opportune for the survey of the development of refrigerated gas-storage methods presented by Drs. F. Kidd and C. West (*J. Pom. and Hort. Sci.*, 14 (4), 299; 1937). The principles underlying the method are given, the considerations governing the construction of gas-tight chambers and the methods of controlling the composition of the storage atmosphere. The following advantages of gas-storage of apples over cold storage in air have been established. (1) Ripening of the fruit at a given temperature proceeds at half the rate in air, that is, the life of the fruit in store is twice as long; (2) low-temperature breakdown is avoided because temperatures are used above the limit at which this develops; (3) firmness of the fruit is preserved almost unchanged over long periods of storage; (4) change in ground colour from green to yellow is markedly retarded; (5) *Tortrix* moth larvae are quickly killed in gas storage; (6) life of the apples after removal from gas storage is remarkably long. An account is given of the normal behaviour of apples after gathering and the influence on this behaviour of temperature, oxygen and carbon dioxide concentration and volatile substances. The information so far available refers particularly to apples and pears, but there seems every possibility that similar methods may be applicable with equal success to plums, peaches, grapes and citrus fruits.

First Crossing of Antarctica

A NOTEWORTHY event in the history of Antarctic exploration was Mr. Lincoln Ellsworth's flight across Antarctica in 1935, a distance of 1,842 nautical miles, from Snow Hill Island, Graham Land, to Little America on the Ross Sea. Mr. Ellsworth's own account, accompanied by a provisional map, appears in the *Geographical Journal* of March. His aeroplane, the *Polar Star*, was large enough to carry fuel for a range of 5,000 miles if only fuel and oil were required and had a 600 h.p. engine and a possible speed of 215 miles per hour. Much of the load, however, had to consist of two months' equipment and supplies for two men. Thus when he took off, the loaded *Polar Star* weighed 7,987 lb., of which 3,614 lb. was the load of the aeroplane and 2,796 lb. (466 gallons) the load of petrol. This was just enough fuel to carry the *Polar Star* across, with four landings on the way. At the final landing, sixteen miles from Little America on the Bay of Whales, the fuel was completely exhausted. Several features of importance were noticed on the way. Stefansson Strait of Wilkins appears to be not more than three miles wide and might even be a fjord and not a strait. This seems to be in accordance with Mr. Rymill's recent discoveries farther west. Eternity Range, south of the strait, showed bold rugged peaks rising to 12,000 ft., in contrast with the lower, flatter summits of Graham Land. Farther on, this range gave way to scattered nunataks and then, in about lat. 78° S., long. 85° W., was sighted the lofty Sentinel Range. Thereafter stretched an apparently unbroken ice-covered plateau at an elevation of about 6,000 ft. to Marie Byrd and Edward Lands.

Sea Breezes

AT a meeting of the Royal Meteorological Society held on February 17, Dr. R. C. Sutcliffe gave the results of an analysis of ten years observations of the wind up to a height of 5,500 feet, made with the aid of pilot balloons at Felixstowe, with the object of studying the behaviour of the sea breeze at various

levels. In order to eliminate days unfavourable for a full development of the sea breeze, those days on which the duration of sunshine shown by a Campbell-Stokes sunshine recorder was less than 70 per cent of the possible duration for the time of year were omitted. The mean direction of the coast at Felixstowe, it may be noted, is from south-west to north-east, a south-east wind being, therefore, an on-shore wind. It was found that when a sea breeze replaces a land breeze as the day advances towards the hottest time, the vector change of speed at right angles to the coast is about 15 m.p.h. on an average up to a height of 500 ft., but is less higher up, becoming very small above about 1,500 ft. Although the average depth of appreciable sea breeze is therefore only about 1,500 ft. at Felixstowe, no definite evidence of a compensating return current was found higher up. The component along the coast behaved so that there was a tendency towards a geostrophic wind in the afternoon, the land being on the left, as though it were a region of low pressure; this coastal component averaged about 5 m.p.h. near the surface, except in the case of northerly winds. With a general inshore wind not due to sea breeze, there was very little increase in the landward component towards the hottest time of the day, but there was a backing of the direction.

Air Temperature during Total Solar Eclipses

IN *Mon. Not. Roy. Astro. Soc.*, 97, 2 (Dec. 1936), Dr. John L. Haughton has a paper in which he describes the apparatus used by him for determining the fall in temperature during the total solar eclipse of June 19, 1936. The instrument responded very rapidly to change of temperature, and it was possible to read to about 0.1°C . by means of the millivoltmeter (1 mv. = 2.1°C .). The maximum fall from a curve indicating what the temperature might have been if there had been no eclipse was only 1.5°C ., and Dr. Haughton thinks that this small fall can be accounted for by the low altitude of the sun and the thermostating effect of the large mass of water. (The observation was taken on board the S.S. *Strathaird*.) When we hear of 'the great fall in temperature' in the case of some eclipses, this is, Dr. Haughton thinks, a fall in radiation temperature, not in air temperature. Comparisons are made between the fall in temperature during this eclipse and the fall in the case of the eclipse of 1927 and also of 1932; but owing to the different conditions, accurate comparisons are impossible, so that the table showing the results has little value.

Composition of the Atmosphere

THE constancy of the percentages of carbon dioxide and oxygen in uncontaminated atmospheric air was established by Benedict in 1912. T. M. Carpenter has now described (*J. Amer. Chem. Soc.*, 59, 358; 1937) several hundred analyses of air made in the period 1930-36 in New Hampshire, Baltimore and Boston. The apparatus was capable of giving burette readings to 0.001 per cent. The grand average of all three series gave 0.031 per cent for carbon dioxide and 20.939 per cent for oxygen. In spite of widely different local conditions of the three laboratories, there was no evidence that variations in season or proximity of large consumers of fuel caused any measurable differences in the carbon dioxide and oxygen content in the atmospheric air. The Boston laboratory is situated near a large power

station and that in New Hampshire near a heavily wooded locality. The deviations from constant values found were very small, the percentage of oxygen having a constancy beyond the accuracy of many atomic weight determinations.

Oxidation of Coal

B. JUETTNER, R. C. Smith and H. C. Howard (*J. Amer. Chem. Soc.*, 59, 236; 1937) have examined the oxidation with alkaline permanganate of a Pittsburg bituminous coal and of a 500° coke made from it. It is shown that 90-95 per cent of the carbon can be recovered in the form of water-soluble, non-colloidal acids, of which aromatic acids correspond with 30 and 35 per cent, respectively, of the carbon in the coal and coke. Good recoveries of oxalic and aromatic acids can be obtained by direct electrolytic decomposition, in a three-compartment cell, of the potassium salts resulting from the oxidation. Oxalic acid and aromatic acids recovered in this way were 88 and 98 gm. per 100 gm. of coal and coke, respectively. It is pointed out that the failure to recover hydrocarbons more complex than diphenyl by decarboxylation does not necessarily preclude the possibility of the presence of acids with condensed aromatic nuclei containing carboxyl oxygen, since drastic alkaline decomposition is known to split the nuclei of such aromatic acids. R. C. Smith and H. C. Howard (*ibid.*, 234) have also shown that the products of pyrolyzing cellulose at temperatures up to 400° contain benzene and diphenyl.

Refraction and Diffraction of Ultra-Short Waves

It is probable that in the near future, ultra-short waves (those below ten metres in length) will be extensively used for television, for short-distance point-to-point communications and for communicating from or between aircraft. Any information, therefore, concerning the physical properties of these waves is of great practical importance. In the *Journal of the Institution of Electrical Engineers* of March, T. L. Eckersley, taking up the theory which has been developed by several eminent mathematicians, shows how it can be explained graphically in a method helpful to radio engineers. Hitherto it has been assumed that the earth has infinite resistivity, and formulæ for the propagation of spherical waves round it have been found. Eckersley has extended the solution to the case of a spherical earth of finite resistivity and has deduced results which, at least partially, are borne out by experiment. The problem is not one that can be solved by geometrical optics but requires the full wave theory for its solution. The author considers that diffraction plays the leading part in controlling short wave propagation, but he has found evidence of variation of signal intensity at extreme distances, which he considers can only be caused by the gradient of the refractive index of the air near the surface of the ground. He considers that the hypothesis that the variations are due to reflections from the ionosphere is a very doubtful one. Water vapour has a high refractive index and the effect of a small percentage present is very pronounced. He shows that there is a gain in the signal strength with height in the regions beyond the visible range. Several observers in America using either aeroplanes or autogyros have observed this increase in the signal strength with height, and their measurements are in fair agreement with theory.

The Indian Science Congress Association

HYDERABAD MEETING

THE twenty-fourth annual meeting of the Indian Science Congress Association was held at Hyderabad on January 2-8, under the presidency of Rao Bahadur T. S. Venkatraman, of the Indian Agricultural Service, who was made C.I.E. in the New Year honour list. Summaries of the presidential address and of the addresses of presidents of the ten sections follow.

THE INDIAN VILLAGE

In his general presidential address, Rao Bahadur T. S. Venkatraman discussed "The Indian Village—its Past, Present and Future". The Indian village, which has remained in a quiescent and more or less petrified state for two thousand years, began as a result of Aryan group settlement in the north. This had produced two types of village, the *ryotwari* village, in which a group or family took up as much land as they thought they could cultivate; and the joint village, in which the founders were powerful families, or clans, who were not agriculturists, the cultivators of the soil owing obligation to these families, and being something in the nature of tenants. These villages were self-supporting, and governed by a council of elders, with a system of village industries, of which the practitioners received a portion of the agricultural produce for their service.

The old self-sufficing village system has now broken down by contact with the West, which has brought in competition and the commercialization of crops, now grown not merely for home consumption, but also for export. In the present-day village, notwithstanding the extension of irrigation, seven-eighths of the population are dependent on the monsoon, rendering agricultural income unsteady and uncertain. The village is out of touch with markets, hence a great part of the profit goes to the city which markets the commodities. The increase of population has grown beyond the capacity of the land, especially as the use of manure, animal and human, is banned by sentiment. Sub-division and fragmentation of land militate against efficiency in production and debar the introduction of capital. The attachment to the cow is now working detrimentally, as an enormous head of cattle is carried, which contributes nothing to profits, the only advantage being an abundance of milk. Labour is uneconomical and inefficient, as well as intermittently employed. The villagers are overwhelmed with debt owing to the fluctuation and uncertainty of their incomes, so that many are reduced to the position of serfs. The standard of village life is low, and compares unfavourably in interest with the life of the city. As a result, all the more intelligent are drawn to the towns.

How can the downward tendency be checked? Some provision has already been made by Government organizations for improvement in agriculture and for technical advance. Fragmentation and sub-division need restrictive legislation, education should be extended in village schools with a rural outlook, while intellectual alertness, business habits and a broader outlook on life should be cultivated in the villagers. The co-operative spirit of the villages of old should be fostered anew. Village industries should be encouraged and commercialized, while if

products were partly manufactured in the area of production, much of the present cost of transport could be saved. Town and village are complementary, each contributing something to the life of the other. The duty of India is clear, the president said in conclusion, namely "to improve the *Village*, the nucleus of our country life, and infect its Chief Agent the *Villager* with a chosen culture of the virus of modern age through *Education* and *Industrialization*."

ABSORPTION OF LIGHT BY ATOMS AND MOLECULES

Prof. S. Datta chose as the subject of his presidential address to the Section of Mathematics and Physics the "Absorption of Light by Atoms and Molecules", and in the course of it summarized the advances made during recent years, giving references to nearly eighty researches. Under atoms he explained the rule according to which the lines absorbed form only one group of those radiated, and showed that it is not rigidly obeyed. The energy levels of the theory of line spectra must be considered of finite thickness in keeping with the 'uncertainty principle'. The width of the absorption lines is due partly to this and partly to the thermal motion of the atoms of the gas. The intensity is best explained by Dirac's theories, but the thermal broadening and the Raman effect may require a sub-division of the quantum for their explanation. The complex motions which may take place in a molecule, even when only diatomic, account for their more complex spectra; but many of the phenomena of absorption are explained on the theory of both attractive and repulsive forces between the constituent atoms, while the continuous absorption bands may be ascribed to the absence of quantization for the normal vibrations.

CHEMISTRY OF ANTIMALARIALS

In his presidential address to the Section of Chemistry, Prof. J. N. Ray discoursed upon the chemistry of antimalarials, a subject of prime importance to India, since the prevalence of malaria is a most formidable obstacle to progress in that country. It is interesting to note that the cinchona bark, which was first used as a febrifuge in the fifteenth century, still furnishes the best specifics against malaria.

Although quinine has not yet been synthesized, its chemical structure is known, and the physiological action of its various groupings has been closely examined. Thus the superiority of quinine to cinchonine as an antimalarial has been traced to its greater solubility in the red blood cells, on account of the presence of the methoxyl group, which alone differentiates it from cinchonine. Again, while stereoisomerism around the secondary alcohol group, which links the quinoline to the quinuclidine ring, has no marked influence on its pharmacological properties, the latter are destroyed by substitution of hydroxyl by hydrogen, chlorine or acetoxy. Oxidation of quinine and cinchonine to the corresponding ketones (quinone and cinchonone) is, however, not sufficient to affect their value, since reduction of the keto-group occurs in the body. The chief factor in antimalarial

action is probably the quinoline nucleus, but the alcohol group plays an auxiliary part. The vinyl group in the side-chain of the quinuclidine ring does not appear to be directly responsible for prophylactic properties, although hydrogenation increases and oxidation destroys the effect.

Among the numerous synthetic antimalarial drugs are *plasmoquine* and *atebrine*, which are derivatives of 6-methoxyquinoline and 2-chloroacridine respectively, each containing the same complex alkylamino-side-chain. Neither plasmoquine nor atebrine, however, has true prophylactic action, for there is no specific action on the sporozites. Plasmoquine is most effective in conjunction with quinine. The combination has been tried on the large scale by the Bengal Government with encouraging results. Robinson and his colleagues have prepared several derivatives, the most promising being 8-(δ -aminobutyl-amino) 6-methoxyquinoline.

A synthetic drug has still to be found which will have curative value in recurrent infection. The alkaloids of opium appear to be of very little value, but the work of Gunn and Marshall on harmaline, which is effective in acute cases, shows that the search need not be confined to the quinoline series.

Prof. Ray appealed for further financial aid for research in pure chemistry.

INDIAN EARTHQUAKES

Mr. W. D. West discussed "Earthquakes in India" in his presidential address before the Section of Geology and Geography. He traced the beginning of their study to Dr. Thomas Oldham, the first director of the Geological Survey of India, who compiled a valuable catalogue of Indian earthquakes, and investigated the Cachar earthquake of 1869, and the advance to its present state mainly to his son, the late Mr. R. D. Oldham, who wrote the report on the Assam earthquake of 1897, a memoir that has been described as being "worthy of a great subject".

Mr. West divided the country into three great zones, one the belt of Tertiary folding to the south of the Himalayas, the second consisting of the frontal trough of alluvium, and the third the whole of peninsular India. The first zone is that in which all the great earthquakes originate, beginning with the peninsula of Cutch (marked by the earthquake of 1819), and bending round through Baluchistan (the Quetta earthquake of 1935 and others), Northern India (the Kangra earthquake of 1905 and the North Bihar earthquake of 1934), Assam (one of the greatest of all earthquakes, in 1897), and Burma (numerous earthquakes from 1839 onwards). Fault-displacements at the surface occurred with only three of these earthquakes, those of Cutch in 1819, Chaman in 1892, and Assam in 1897.

Mr. West also directed attention to two subjects of great importance, the provision of earthquake-proof buildings in the two northern zones, which coincide with the most populous districts of India, and the foundation of an earthquake research institute for the detailed study of Indian earthquakes.

INDIA'S CLIMAX VEGETATION

Mr. H. G. Champion's address before the Section of Botany directed attention to the neglect of the forest and the tree by the Indian botanical investigator, a neglect that is the more surprising in view of the fact that some twenty-five per cent of Indian

land is under forest, and that the natural climax vegetation for the greater part of the land surface is probably forest.

Mr. Champion pointed out that the direct application of transpiration data from European observations to Indian conditions without verification "is positively dangerous"; yet the comparison of forests with other types of soil cover and their study in relation to the water economy of the land surface represent problems of great importance to India.

Similarly the lac industry, the supplies of valuable gums, dammars, resins, etc., could benefit by studies of tree physiology, while Mr. Champion's own studies upon the 'spiral grain' of the Chir pine have given an indication of the significance that genetic studies may yet have for Indian forestry.

INDIAN CONTRIBUTIONS TO HELMINTHOLOGY

The presidential address to the Section of Zoology was delivered by Dr. Gobind Singh Thapar. The subject chosen was that of helminthological research in India. Beyond doubt, the subject offers great possibilities in that country, where, apart from valuable work on its medical and to a less extent on its veterinary aspects, comparatively little has been done until recently, when new lines have been opened up and schemes of co-operation set in being. Certain references to helminths in ancient writings, among which possibly *Enterobius vermicularis*, microfilariæ and tapeworms can be recognized, were cited, and the present position of the science outlined. It was pointed out that difficulties arise from the fact that an obsolete terminology is still employed in many general text-books of zoology and there are even errors, sometimes serious ones, in the accounts of the life-histories of common forms.

The helminth fauna of India other than those members of it responsible for human helminthiasis is largely unexplored. Details of the morphology of some helminths, *Ascaris*, *Enterobius* and *Labidurus* were given to illustrate how they may play their part in solving problems of classification and relationship. Attention was directed to the discovery of an *Echinococcus* cyst that simulates a *Cœnurus* cyst in that it lacks the typical brood capsules. Brief notice was taken of plant nematodes, host specificity, anthelmintics, pearl formation, etc.

The address concluded with an appeal for a wider appreciation of the importance of helminthological study in India, and for further co-operation among the various workers. Some aspects of this address have been more fully elaborated by the author elsewhere (Lucknow University Studies, 3).

ETHNOLOGY OF THE COORGS

In his presidential address to the Section of Anthropology, Dr. Dewan Bahadur L. K. Ananthakrishna Iyer presented "An Ethnographical Study of the Coorgs". Inscriptions throw little light on the early history of the Coorgs, but from historical evidence it is conjectured that they were not without racial admixture from a remote period. There has been also a great deal of culture contact between the Coorgs and the people of Malabar, Canara and the Tamil districts. Their language is a mixture of Dravidian languages. In physical traits their mountain habitat has differentiated them from the people of the plains. In their economic life they are first hunters and fishermen, and then agriculturists.

Agriculture, which is of the rudest kind, is similar to that carried on in other parts of India. It has been transmitted unchanged for ages. The industry of the people of the highlands is confined exclusively to the cultivation of rice. Though agricultural implements are few and rude, enough has been produced from ancient times to meet home consumption and to export to Malabar. Where possible the valleys have been formed into flat terraces for cultivation.

The agricultural year opens about the middle of April, when ploughing begins with the first shower. This is a ceremonial observance, in the course of which the ancestors, the river deity and the presiding deity of the division of the district are invoked, and prayers are offered to Siva. Before the completion of the transplanting of the largest field, an open space ten feet wide is left the whole length to provide the race ground for the Coorg sport.

Food supply is plentiful. The Coorgs rear sheep and goats, and the chief article of their diet is rice. Hospitality is proverbial. The houses are situated close to the paddy fields, and resembles the Nayar house. The approaches to the old Coorg house mark the design of fortification, pointing back to the old days of general feuds. Their dress and ornaments are peculiar. Their marriage customs are a medley of old and new. Formerly marriage festivities had a communal character. The Coorg family is joint and patriarchal, and no family affair of any importance may be undertaken without the knowledge of the senior member. The senior female member is the queen of the household. Public morality is controlled by a council of elders. The Coorgs are animists, having ancestor and demon worship; but they show evidence of the influence of outside beliefs. Of late they have begun to worship the Hindu deities.

AGRICULTURE IN INDIA

For the presidential address to the Section of Agriculture, Rao Bahadur B. Viswa Nath took as his subject, "Science and Practice of Agriculture". Indian soils and agricultural practices, he said, were several centuries old and research should, and was, concerning itself more with details of existing practices than with the evolution of wholly new methods, the aim being to build up on the existing system a state of agriculture suited to the conditions of the soil and the resources of the cultivator.

Work on soil had originally been confined to a study of fertility, but other aspects were now known to be important, and it had been found that characteristics and reactions of different soils were determined by climatic factors rather than by their geological origin. As regards manuring, the importance of organic manures for Indian soils was stressed. Intensive cultivation and continued use of artificial fertilizers were liable to lead to evil consequences if they were not accompanied by the addition of adequate organic matter; in fact, the utilization of the increased knowledge of the soil obtained by research would be in proportion to the building up of the reserves of organic matter in the soil. Further, the nutritive value of a crop was enhanced by the use of organic manure. With the view of meeting this need, much attention had been paid to the utilization of animal and vegetable waste products. Composting had achieved considerable success, but a simpler and cheaper method was still required if

it was to be more generally adopted by Indian agriculturists.

In conclusion, the president showed that there was considerable scope for increased production, as the present yield of food crops was sufficient for the proper feeding of only two-thirds of the Indian population.

ANIMAL NUTRITION AND PUBLIC HEALTH

"The Relation of Animal Nutrition to Public Health in India" was the title of the presidential address to the Section of Medical and Veterinary Research, delivered by Colonel A. Olver. He pointed out the causative role of faulty nutrition in relation to many diseases from which livestock suffer in various countries. Thus, 'bush-sickness' in New Zealand and elsewhere is due to iron deficiency, and calves in India develop a form of blindness caused by vitamin A deficiency in the fodder; well-fed meat and milk of good quality are of higher biological value than similar material of lower quality. In India every year there is a period when natural growth of succulent fodder is almost at a standstill, and when the foodstuffs available for stock are mostly dry, over-ripe crop residues lacking in mineral, vitamin, and other essential constituents. This reacts upon the population, who cannot thrive when the meat is poor and the milk is deficient in quantity and quality.

Colonel Olver therefore urged that more attention and research should be bestowed upon the production of fodder crops of good quality. The production of suitable fodder crops economically in a system of agriculture that is largely governed by the limited capital resources of Indian cultivators is, however, one of the most difficult of the problems with which the better nourishment of the people of India is unfortunately confronted.

INDIAN PHYSIOLOGY

Lieut.-Colonel S. L. Bhatia commented, in his presidential address before the Section of Physiology, on the melancholy fact that in spite of the great importance of a knowledge of physiology among those who are responsible for the well-being of the people, this subject has been little studied in India, in comparison with physics and chemistry. The Section of Physiology of the Association, which celebrates this year its first anniversary, looks forward to a period of vigorous growth, in which professors of physiology now established all over India in full-time chairs with well-equipped laboratories, will direct their energies particularly towards problems of special importance to India—problems of nutrition, of adaptation to tropical climates, and of the application in India of methods which have already been applied in the West.

Colonel Bhatia emphasized the practical importance of physiology by reviewing the growth in Europe of this offspring of medicine, which has had so much influence on its parent, and which has never been so abstract and impractical as some of its critics believe. The decision of the Royal College of Surgeons of England to hold a primary F.R.C.S. examination each year in India will give a great impetus to the study of physiology in all the medical colleges.

The president read quotations from some of the letters of greeting and encouragement which the

Section had received from leading British physiologists. Prof. A. V. Hill spoke of the international character of physiology and of its status as an independent science. If physiology had been content to be merely the handmaid of medicine and to give important positions only to medical men, it would have missed many of its ablest exponents—Pasteur, Langley, Barcroft, Cannon, Bayliss, Lucas, Krogh, Lapique, and many others, including, we may add, A. V. Hill himself.

SOCIAL MIND OF THE INDIVIDUAL

K. C. Mukherji took, for the subject of his presidential address to the Section of Psychology, the "Social Mind of the Individual". He regretted that there should be any controversy about the importance of social compared with individual psychology, since it is a matter of observation that individual psychology depends as much upon the psychology of society as the psychology of society upon it.

While admitting the importance of the institution of the family life for the welfare of the State in its material aspects, he emphasized that the mental effects of the family life in relation to the foundations

of national sentiment are equally important. Although the effects of family life on one hand may be a barrier to the development of wider social interests, it is, however, the necessary preparation for the foundation of the social sentiments. The views of various writers on the ultimate elements of social interests were critically considered.

Mr. Mukherji thinks that life in the first instance is a social life which grows unconsciously, but, when with advancing individual development the critical spirit arises, the unconscious acceptance of the social group becomes modified by conscious effort; thus the social life may be said to be individualized.

The relation of the individual to the group led him to consider the relationship between minor groups under the political, economic, or cultural dominance of a major group. If the minor group accepts the dominance of the major group, there is no trouble; if the minor group assumes an attitude of equality or superiority in some field, it threatens the prestige of the major group, and fear of that loss tempts to aggression. He thinks that this represents the problem of the Jews in Germany, and the Hindu-Muslim tension. The address raised some very interesting problems in a clear form.

X-Ray Studies of Proteins

At the thirty-seventh lecture of the Bedson Club at Armstrong College, Newcastle-on-Tyne, on March 5, Dr. W. T. Astbury gave an account of his work on the "X-Ray Interpretation of Protein Structure".

Proteins can be divided into two classes, fibrous and globular, and they all contain α -amino acids condensed, primarily, as polypeptide chains. This classical theory of Emil Fischer does not fully characterize the proteins, and research has shown that these long polypeptide chains are folded and further cross-linked by the reactive centres of the side chains. In dealing with the proteins, it is necessary to ask three questions: What are the side chains? How are they distributed? And what is their stereochemical aspect? Dr. Astbury dealt with the last topic.

The fibrous proteins are mainly stable, the simplest being fibroin (silk protein) which consists largely of glycine and alanine residues. Its X-ray photograph agrees with the view of a fully extended polypeptide chain, and this is confirmed by the fact that silk fibres cannot be reversibly stretched. Any stretching that does occur is permanent and due to the crystallites sliding over one another. The stretching of wool, hair, etc., is about a hundred per cent and reversible, and the usual X-ray photograph is not the same as that of fibroin; but on stretching, a similar photograph has been obtained, indicating that keratin (the protein of hair) is a fully extended polypeptide chain system only in the stretched state (β -keratin); the unstretched condition is known as α -keratin. It seems, therefore, that in the β -keratin form the proteins consist of parallel polypeptide chains linked by cross-linkings, while in the normal or α -form these chains are folded. If keratin is stretched and steam applied, the cross-links are hydrolysed and

the extension then becomes permanent by the formation of new cross-links. Keratin fibres can also be contracted by nearly fifty per cent (supercontraction) due to further folding of the main-chain. This supercontraction of hair has been found to be very similar to the contraction of muscle. The extension and contraction of many fibrous proteins can take place by free rotation around the single valency links, and therefore unreasonable straining of the valency bonds does not occur.

The globular proteins are only stable within narrow limits. Some of them have been obtained in a crystalline state, and in this condition X-ray investigation has been possible. Svedberg, by means of the ultracentrifuge, has indicated that the molecular weight is a simple multiple of 35,000 (approx.). The characteristics of this class are rapidly lost on denaturation, and the stretched state of the denatured protein gives X-ray photographs very like those of β -keratin and the stretched fibres in general, thus showing that all proteins, whatever they are in the natural state, can be brought to a condition approximating to long polypeptide chains with cross-links.

The folding of these chains must be specific, and Dr. Astbury discussed possible methods by which this could take place, and indicated how supercontraction was brought about. The specificity argues some controlling factor, and it was suggested that this is a property of the side chains.

In conclusion, Dr. Astbury dealt with the feather protein and the virus which causes 'mosaic' disease in tobacco plants. The former falls between the fibrous and globular, while the latter, analogous in several ways to feather protein, appears to be no other than a crystallizable protein bridging the supposed gap between living and non-living matter.

Observations of the Aurora and the Zodiacal Light

IT is one of the attractions of astronomy that useful spheres of work are open to all ranges of instrumental equipment from the largest to the smallest, whilst a few phenomena are best observed initially without a telescope at all. In the category of phenomena for naked-eye study are included the aurora and the zodiacal light, though for critical research these also require the camera, photometer and spectroscope. A memoir issued by the British Astronomical Association (32, Part 3) summarizes the work carried out since 1931 by the section under the directorship of Mr. W. B. Housman, dealing with the aurora and zodiacal light.

The observations were made in Great Britain, in which artificially illuminated skies often present serious difficulty in recording these delicate phenomena, and also in Australia, where for several reasons the conditions tend to perfection for the observation of the zodiacal light. The fascination of watching auroral displays is conveyed by the frontispiece, which reproduces a drawing, made by the late Dr. W. J. S. Lockyer from a ship off the coast of

Labrador, of the aurora borealis of August 5, 1932. Owing to their increasing frequency with the rise in solar activity, records of the aurora are of interest to radio research workers and other geophysicists interested in upper air phenomena, as well as to astronomers who look to the sun for clues of their origin.

Observations of the zodiacal light (including the zodiacal band and *Gegenschein*) are being vigorously pursued in a systematic manner. The reality of both short- and long-period variations in the apparent brightness of the zodiacal band is being investigated by a longitudinal chain of workers from Australia to Japan. The observations made by the Section since 1931 (and especially those made by the Rev. R. B. Bousfield, of Queensland) strongly suggest a general variation with that of the 11-year solar cycle. A chart of the zodiacal band, drawn by Mr. H. Jarvis from Bousfield's observations and his own, and first published in *Mon. Not. Roy. Astro. Soc.*, 1934, is reproduced in the memoir; it fills a gap in existing star maps and handbooks.

The Automatic Radio Compass

IN the October number of the quarterly journal entitled *Electrical Communication* published by the International Standard Electric Corporation, there is a paper by H. Busignies describing the automatic radio compass and its applications to aerial navigation.

Ten years ago, attempts were made to develop a compass system, called the 'Hertzian compass', in which the angles indicating the position of a radio transmitter appeared automatically on a graduated scale, similar to the scale of an ordinary magnetic compass. Rough models were made and the essential principles established. Exhaustive trials were made with the collaboration of the French Air Ministry, and commercial production was commenced. It gives an automatic and unbroken visual indication of the direction of a radio station by showing the angle between the direction of this station and the aeroplane's axis. Le Matériel Téléphonique, Paris, constructs a radio compass (R.C. 5 Radio Compass), which indicates the direction of a transmitter on a dial graduated in degrees completely round the circle.

The radio compass may be described as an automatic radio goniometer. It indicates the direction of chosen transmitters which may be situated at any points round the aeroplane. The apparatus is based on the following principle. When a receiving loop aerial turns regularly round a vertical axis, maximum reception occurs every time that the plane of the loop passes in the direction of the transmitter. If the loop turns at a constant speed, a certain number of maxima and minima receptions per second can be observed in a receiver turned on to a transmitter. A rotating speed of five revolutions per second has been chosen as the standard, maxima

and minima of receptions taking place at ten per second. The phase of these maxima and minima, that is, the moment at which they occur in connexion with a given origin, depends on the direction of the transmitter in relation to the axis taken as origin. If the location of the transmitter changes in relation to the radio compass, the minima and maxima phases also change, and it is the changing of the phases which is utilized in the apparatus to obtain the automatic indication.

A two-phase current generator the phase of which is constant in relation to the revolutions of the rotating loop is placed on its rotating axis. The two-phase current creates a rotating field in a magnetic stator which may be compared to the stator of a synchronous motor. This field rotates at a speed double that of the loop. The variable current from the receiver actuates an armature carrying a pointer associated with a dial. In this armature, therefore, an alternating current is produced by the rotation of the receiving loop, and in the stator a fixed phase rotating field by the two-phase machine. Thus the magnetic reactions of one flux on the other give a definite position to the armature, which sets itself perpendicularly to the flux. The radio compass does not itself indicate the 'sense' of direction, but this 180° ambiguity can be eliminated in several ways. Little if any trouble arises from interference of transmitting stations. The total weight of the apparatus is about 50 lb., depending on the size and type of the aeroplane. The guaranteed accuracy of the apparatus is $\pm 2^\circ$ for a distance of 300 miles from a 300-watt transmitter.

Guided by the radio compass, the aeroplane always flies in the direction of the station and, if

there is no wind, it flies in this direction along a great circle. When there is wind, the pilot determines the drift angle when starting by noticing the course which gives a constant reading of the magnetic compass with a constant indication of the radio compass. Thus, when the correct drift angle has been determined the compass readings can be corrected. In France, both civil and military aviation authorities have submitted the compass to exhaustive trials, and many aeroplanes are already equipped with them.

University Events

ABERDEEN.—At the spring graduation held on March 31, the honorary degree of LL.D. was conferred upon the following, among others: Olaf Bloch, head of the Research Department, Ilford Laboratories; Naughton Dunn, surgeon and lecturer in orthopaedic surgery in the University of Birmingham; Prof. A. W. Gibb, emeritus professor of geology in the University; Dr. J. F. Tocher, lecturer in statistics in the University.

CAMBRIDGE.—Dr. F. P. Bowden, fellow of Gonville and Caius College, has been appointed Humphrey Owen Jones lecturer in physical chemistry in succession to Dr. R. G. W. Norrish.

S. D. Elliott has been appointed University demonstrator in the Department of Pathology.

Dr. R. van der R. Woolley has been appointed to the John Couch Adams astronomy and as first assistant observer at the Observatory.

The Amy Mary Preston Read scholarship, value £150, awarded this year for research in scientific subjects, has been gained by J. W. S. Pringle, of King's College, who graduated with a double first in natural sciences in zoology and comparative anatomy in 1934.

GLASGOW.—Dr. George L. Montgomery has been appointed Gardiner lecturer in the pathology of diseases of infancy and childhood.

Sir William Waters Butler has contributed £100 towards the cost of erecting the new Chemistry Institute.

At the Commemoration Ceremony on June 16, the honorary degree of LL.D. will be conferred on: Prof. Jan Boeke, professor of histology and embryology in the University of Utrecht; Sir Robert Muir, emeritus professor of pathology in the University of Glasgow; Prof. Max Planck, emeritus professor of theoretical physics in the University of Berlin; Sir Albert Seward, emeritus professor of botany in the University of Cambridge, recently master of Downing College, Cambridge.

OXFORD.—Sir William Beveridge, director of the London School of Economics and Political Science since 1919, has accepted the invitation to become master of University College in succession to Dr. A. B. Poynton, and will take office on October 1 (see also p. 619).

M. H. Hey, Magdalen College, has been granted the degree of D.Sc. for his work in mineralogy.

The Halley lecture for 1937 will be given on May 28 at 5 p.m. in the University Museum by Dr. B. F. J. Schonland of the University of the Witwatersrand. His subject will be "The Lightning Discharge".

Science News a Century Ago

Brunel on the Thames Tunnel

At a meeting of the Institution of Civil Engineers on April 11, 1837, Brunel gave an account of the progress being made with the construction of the Thames tunnel, then the greatest work of its kind under construction. The tunnel previously begun by Vazil and Trevithick, he said, had been only about 5 ft. high and 3 ft. wide, whereas the tunnel now being made was 38 ft. wide and 22 ft. high, and it was being excavated by the aid of a shield. This shield consisted of twelve parallel frames ranged side by side, each divided into three cells. Each frame was made so that it either derived support from its neighbour or assisted in supporting those adjacent. The advantage of the system which had been adopted of building by rings had been demonstrated by the fact that the brickwork had sustained two eruptions of the river, but had exhibited no sign of rupture. The great inconvenience suffered was through the want of a drain; an attempt to make one had been made, but after getting into a stratum of quicksand 50 ft. thick, it had to be abandoned. The land springs were a source of annoyance; many of them were extremely offensive, and produced cutaneous eruptions and were an annoyance to the workmen. The difficulties were great, but they would in time be surmounted.

The University of Cambridge and Gresham College

In 1836 William Palmer (1802–58) was appointed professor of law at Gresham College, London. In his inaugural address he dealt in an interesting manner with the history of the foundation of the College. His address occupied two closely printed columns in *The Times* of April 13, 1837. After referring to the career of Sir Thomas Gresham, Queen Elizabeth's visit to his house in Bishopsgate Street on January 23, 1570, and Gresham's determination to found a college for the several sciences in the City, Palmer quoted from a letter dated March 25, 1575, from the vice-chancellor and senate of the University of Cambridge addressed "To the most accomplished Sir Thomas Gresham, the best mæcenas of good learning", urging that the college should be founded at Cambridge and not in London. The letter was in Latin, but the translation ran: "In urging this alone, we would not so strongly or so long contend, unless for the convenient fitness of the place, and for the wholesome state of the air, and usefully for the dignity of the State, and piously for the defence of religion, and fruitfully for the progress of virtue, and happily and fortunately for the advancement of learning and splendidly as well as gloriously for thine own everlasting fame thou mayest erect thy college here rather than in any other place." The college should be at Cambridge or Oxford, but not in London, "to the detriment or almost ruin of either university."

But the compliments of the University could not divert Gresham from his purpose, as seen by his will of July 5, 1575. After his death and that of Lady Gresham, the City and the Mercers Company came into his estates, and the latter applied to Cambridge and Oxford for advice as to the appointments to be made, with the result that of the first seven lecturers three came from Cambridge, three from Oxford and one was appointed on the recommendation of the Queen.

Henderson's Star Observations at the Cape

ON April 14, 1837, Thomas Henderson (1798-1844) read a paper to the Royal Astronomical Society entitled "On the Declination of the principal Fixed Stars, deduced from observations made at the Observatory, Cape of Good Hope, in the years 1832 and 1833". Henderson had been appointed to succeed Fallows at the Royal Observatory at the Cape of Good Hope in 1831. He arrived there in April 1832, but had to resign in the following year on account of ill health; and in 1834 was made the first Astronomer Royal for Scotland. In the short time he was at the Cape he did much valuable work under considerable difficulties. In the last of the tables given in his paper in 1837, Henderson included a list of 31 stars, with their direct and reflected zenith distances with the differences he found.

Samuel Hall's Marine Surface Condenser

IN the *Nautical Magazine* of 1837, p. 330, it is recorded: "On Saturday, April 15, Mr. Hall's patent improvements on steam-engines, as applied to a pair of 180 horse-power on board the *Hercules* steam-vessel, were investigated by Sir William Symonds and Mr. Ewart, on the part of the Lords Commissioners of the Admiralty. Several scientific gentlemen and others interested in steam navigation were also present. The party proceeded down the river in the *Hercules*, as far as Gravesend, and were well satisfied with the superior working of the engines and the successful competition of the *Hercules* (though laden so as to draw 12 ft. 4 in. water) with other vessels of the finest build, and the best engines, working by injection. The *Hercules* has been running regularly for a year and a quarter between London and Cork; and these improvements besides having stood nearly a three years and a half trial, in a steam packet plying in salt water, the great and important advantages of Mr. Hall's improvements may be considered as established, leaving no doubt that injection engines will hereafter be entirely superseded."

Giovanni Rasori (1766-1837)

PROF. GIOVANNI RASORI, the founder of the once popular but long extinct doctrine of contra-stimulation, whose death took place on April 15, 1837, was born at Parma on August 20, 1766, the son of a hospital dispenser. After qualifying at Pisa at the early age of nineteen years with a thesis on the more recent ideas in medicine, he spent three years at Florence as assistant to the celebrated surgeon Fontana, and the next two years at Pisa, where he studied under Spallanzani and Peter Franck. In 1795 he travelled to England and visited London, Oxford, Cambridge and Edinburgh, where he made the acquaintance of John Brown, the founder of the Brunonian system.

Rasori's doctrine of contra-stimulation was a modification of the Brunonian system, according to which all remedies except bleeding have a stimulating action and only differ from one another in their degree of stimulation. Unlike Brown, however, he held that in the great majority of cases diseases are caused by excess of stimuli and only a few are due to lack of stimuli. He maintained, therefore, that two kinds of drugs were needed, namely, contra-stimulants, of which tartar emetic was the best example and stimulants, such as ammonia, alcohol and ether.

Societies and Academies

Paris

Academy of Sciences, March 1 (*C.R.*, 204, 625-732).

ALFRED LACROIX: A fall of stony meteorite in New Caledonia, on July 16, 1936.

EMILE BOREL: The approximation of real numbers by rational numbers.

GEORGES GIRAUD: Equations and systems of equations in which figure principal values of integrals.

EMILE MATHIAS, CLAUDE AUGUSTE CROMMELIN and J. J. MEIHUIZEN: The curve of densities and rectilinear diameter of krypton. For temperatures below 190° C. absolute, krypton follows the law of the rectilinear diameter.

EDOUARD CHATTON: A new element of the structure of the Sporozoa: the argyrome.

ANTONIO CALICHIOPULO: The method of selection of the errors of observation.

ILIE POPA: Periodic Laplace series.

LOUIS PASQUALINI: The convexity of a disk of the surface $z=f(x,y)$ projected on the plane xOy along a convex figure K and the second paratingent of which is void, except on a point shaped ensemble.

JEAN DELSARTE: A generalization of the Euler-MacLaurin formula.

JOSEPH FAYET: The reduction of homogeneous, linear differential equations to equations with constant coefficients.

PIERRE LELONG: The Lindelöf principle and the asymptotic values of a meromorphic function of finite order.

F. J. BOURRIÈRES: The self-maintained oscillations of the extremities of elastic tubes emitting a continuous current of fluid and those of free reeds fitted in at the top.

JEAN CAPELLE: The matching of helicoidal gears.

PIERRE CLERGET: A machine for classifying combustible liquids according to their advance in inflammation under the conditions of use in compression ignition motors. The results obtained with the machine described show that the relation between the ketene number (Boerlage) and the delay in ignition is not linear, but has a hyperbolic tendency.

PIERRE DIVE: The variations of the angular velocity in a fluid star.

JEAN DUFAY, M^{lle}. MARIE BLOCH and JOHN ELLSWORTH: The emission of CO^+ bands in the head of Peltier's comet (1936, *a*). The CO^+ bands were well marked in the spectrum of the head of Peltier's comet, but the spectrum of the tail was too weak to be photographed under the same conditions.

JULES GÉHÉNTAU: The moments of impulse in the photon theory of L. de Broglie.

ROBERT GUILLIEN: The utilization of relaxation oscillations for the measurement of capacities. The method described allows rapid and exact measurements and is specially suitable for the study of the dielectric constants of liquid gases.

PIERRE JACQUET: The structure of electrolytic deposits. The experimental results confirm the hypothesis of N. Thon relating to the inhibition of the active centres of a polycrystalline metallic cathode, and show that the discharge of the hydrogen ions plays an essential part in the structure of the metals of the iron group and of all metals obtained in complex baths.

ST. PROCOPIU and G. VASILIU: Magnetization discontinuities in an alternating field. Explanation of the multiple frequencies appearing in ferro-resonance.

NICOLAS KÜRTI, PAUL LAINÉ, and FRANZ SIMON: Researches on the ferromagnetism of ferric ammonium alum.

PIERRE BARCHIEWITZ: The position of the CH bands of the halogen derivatives of the saturated hydrocarbons and the electric moment of these molecules.

JEAN TERRIEN: The stimulation by resonance of the fundamental doublet of copper in the vapour of cuprous chloride.

JEAN PAUL MATHIEU: Researches on the Werner complex compounds. The Raman spectra of 4- or 6-co-ordinated compounds.

MAURICE LEMOIGNE, PIERRE MONGUILLON and ROBERT DESVEAUX: The characterization and micro-estimation of nitrates.

S. Lj. YOVANOVITCH: A new electro-analytical method for the determination of antimony.

HENRI GEORGE and ROGER LAMBERT: The dissociation of zircon. Zircon, fused in an electric furnace and rapidly cooled, is completely dissociated into silica and zirconia (ZrO_2).

ARMAND MARIE DE FICQUELMONT: The constitution of mineral rubber. Studies on the phosphonitrile chlorides, $(PNCI_2)_x$.

Mlle. YVONNE GARREAU: The preparation and constitution of cyclohexylammonium 2,5-dicyclohexylamino-1,4-quinone-3,6-disulphonate, of 2,5-dicyclohexylamino-1,4-quinone and of hydroquinone-2,5-disulphonic acid.

ANDRÉ CORNILLOT: A mode of representation of organic compounds.

MARCEL TUOT: The formation of nitroschlorides starting with C_6 to C_{11} ethylenic hydrocarbons.

CHARLES PRÉVOST and JOSEPH WIEMANN: The iodizing properties of the iodo-argento-benzoic complex compound.

STANISLAS GOLDSZTAUB: The crystalline structure of laurionite.

ANDRÉ RIVIÈRE: The granulometric constitution of the sandy sediments and the broad lines of their evolution in different geological media.

L. CLARIOND and Mlle. YVONNE GUBLER: The presence of Acadian and post-Acadian eruptive rocks to the south of Djebel Ougnat (South Morocco).

LÉVI HERMAN and Mlle. FANNY BERNSTEIN: The relations between the variations of the intensity of the ultra-violet solar radiation, measured at the level of the soil, and the pollution of the lower atmosphere.

JOSEF SZULETA: The tannin cells in the pith of the elder (*Sambucus nigra*).

ANDRÉ SARAZIN: The evolution of the chondriome and of the vacuolar system in the carpophores and especially in the basidia of *Agaricus campestris*.

MME. JEANNE WERNER and ROGER GUY WERNER: The study of some lichen gonidia isolated in a pure culture.

PIERRE LEPESME: The external action of arsenical preparations on insects.

GABRIEL GUIGNON: The post-nymphal development of the wings of the Lepidoptera.

RENÉ SALGUES: The preventive fungicidal properties of methylene blue in animal pathology.

ANTOINE MAGNAN and HENRY GIRERD: Attempts at the cinematography of the wings of birds in motion in three mutually perpendicular directions.

WLADISLAS KOPACZEWSKI and RENÉ PAILLE: Gel formation of whole blood.

MME. RAYMONDE DUVAL: The action of the electric current on hæmoglobin in the presence of different electrolytes.

ALEXANDRE BESREDKA and LUDWIK GROSS: Intracutaneous immunization against epithelioma and its mechanism.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 1-39, January 15).

S. ATWOOD: The last premeiotic mitosis and its relation to meiosis in *Gaillardia*.

A. C. KINSEY: An evolutionary analysis of insular and continental species. Nearly 400 species of the family Cynipidæ (gall wasps) have been studied in the United States, Mexico and Guatemala. These wasps provided good material for the study of insular species because each is restricted to a single kind of oak or group of related oaks, and further, the oak hosts in the western area are limited to high mountain elevations. Some 76 per cent of the wasps are classified as insular species. They are usually homogeneous in constitution, and show few local populations and few inter-specific hybrids; mutation and early isolation of new types are the important factors in increasing the number of such insular species.

G. BIRKHOFF: Integration of operators.

G. A. MILLER: Groups which contain an Abelian subgroup of prime index.

J. v. NEUMANN: Algebraic theory of continuous geometrics.

W. J. CROZIER and A. H. HOLWAY: On the law for minimal discrimination of intensities (1). As a result of a discussion of visual, auditory and other data, it is concluded that the properties of a marginal discriminable interval of intensity are determined by probability considerations, and are completely independent of specific structural and other properties of the receptor field. It is important to use homogeneous data.

MORGAN UPTON and A. H. HOLWAY: The psychophysics of hearing. (1) Monaural differential sensitivity and exposure-time. A relationship has been determined between the just noticeable increment in intensity and the exposure time, utilizing one ear and continuous increase of intensity, at three levels of intensity. (2) Binaural differential sensitivity and exposure-time. The same relationship found for one ear applies when two are used, but the just noticeable increments of intensity are lower at each level for binaural hearing.

E. WITSCHI: Stimulative and inhibitive induction in the development of primary and secondary sex characters. Work with salamanders united experimentally with a strand of tissue containing blood vessels, gives evidence of the production by the medulla of the gonad of two inductive substances. One stimulates testicular differentiation, but within the gonad only; the other inhibits ovarian differentiation of the cortex and is carried in the blood like a typical hormone. These substances are not the same as the testicular hormone, which stimulates merely the last functional development of the male secondary sex characters.

Forthcoming Events

Monday, April 12

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Prof. E. G. R. Taylor: "The Geographical Ideas of Robert Hooke".

Tuesday, April 13

ILLUMINATING ENGINEERING SOCIETY, at 7.30.—G. T. Winch and L. Jesty: "Television Images: an Analysis of their Essential Qualities".

Thursday, April 15

INSTITUTION OF CIVIL ENGINEERS, at 6.—J. L. Savage: "The Boulder Dam".

CHEMICAL SOCIETY AND SOCIETY OF CHEMICAL INDUSTRY, at 8.—Joint Discussion on "Physico-Chemical Problems involved in Distillation" to be opened by Prof. J. Reilly.

Friday, April 16

INSTITUTION OF ELECTRICAL ENGINEERS (METER AND INSTRUMENT SECTION), at 7.—J. B. Kramer: "The Photocell and its Applications in Industry".

ROYAL INSTITUTION, at 9.—T. Macara: "Science and the Conservation of Food. Some Special Problems".

BRITISH PSYCHOLOGICAL SOCIETY, April 16–20.—Extended General Meeting to be held at the University of Manchester.

Appointments Vacant

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

JUNIOR ASSISTANT MYCOLOGIST in the Midland Agricultural College, Sutton Bonington, Loughborough—The Principal (April 12).

ASSISTANT ENGINEER in the Mechanical and Vehicle Engineering Section of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, London, S.W.1 (April 12).

CHEMICAL ENGINEER at the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk (April 14).

JUNIOR SCIENTIFIC OFFICER at the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (April 20).

SEROLOGIST in the Ministry of Health—The Director of Establishments, Ministry of Health, Whitehall, S.W.1 (April 24).

LECTURER IN CHEMISTRY in the Natal University College, Pietermaritzburg—The Registrar (May 31).

INSPECTOR OF AVIATION FUELS AND LUBRICANTS in the Aeronautical Inspection Directorate—Secretary, Air Ministry (S.2.d.), Adastral House, Kingsway, W.C.2.

SECRETARY of the Institution of Gas Engineers, 1 Grosvenor Place, S.W.1—The Secretary.

Official Publications Received

Great Britain and Ireland

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1935–1936. (Cmd. 5378.) Pp. 172. (London: H.M. Stationery Office.) 3s. net. [173]

Rubber Growers' Association. Rubber and Agriculture Series. Bulletin No. 6: The Uses of Rubber in Commercial Horticulture. By Alexander Hay and D. F. C. Vosper. Pp. 16. (London: Rubber Growers' Association.) Free. [173]

University of Leeds in association with the Royal Bath Hospital, Harrogate. Annual Report of the Advisory Committee on Research into Rheumatism, 1936. Pp. 4. (Leeds: The University.) [183]

University of Sheffield. Report on Research Work carried out in the Departments of Mining and Fuel Technology during the Session 1935–1936. Pp. 20. (Sheffield: The University.) [183]

The Thoroton Society of Nottinghamshire: Excavation Section. First Annual Report for the Year 1936. Pp. 35. (Nottingham: Thoroton Society of Nottinghamshire.) [183]

The British Broadcasting Corporation. Tenth Annual Report, 1936. (Cmd. 5406.) Pp. 32. (London: H.M. Stationery Office.) 6d. net. [223]

Falmouth Observatory. Report of the Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council. By H. Dent Gardner; Meteorological Notes and Tables for the Year 1936, with Mean Values for 65 Years (1871–1935), by W. Tregoning Hooper. Pp. 13. (Falmouth: Falmouth Observatory.) [223]

Other Countries

Canada: Department of Mines: National Museum of Canada: Bulletin No. 81 (Anthropological Series No. 18): Anthropometry of the Beaver, Sekani and Carrier Indians. By J. C. Boileau Grant. Pp. ii+37+6 plates. 25 cents. Bulletin No. 82: Annual Report of the National Museum for the Fiscal Year 1935–36. Pp. 24. 10 cents. (Ottawa: King's Printer.) [153]

Canada: Department of Mines, Bureau of Economic Geology: Geological Survey. Memoir 191: Lode Gold Deposits of Ymir-Nelson Area, British Columbia. By W. E. Cockfield. (No. 2415.) Pp. ii+78. 25 cents. Memoir 196: Geology of Lake Athabaska Region, Saskatchewan. By F. J. Alcock. (No. 2420.) Pp. ii+41+8 plates. 25 cents. Memoir 203: Geology of Teslin-Quiet Lake Area, Yukon. By E. J. Lees. (No. 2429.) Pp. ii+30+2 plates. 25 cents. (Ottawa: King's Printer.) [153]

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1929–1930. Part 2. Pp. xiii+382+29 plates. (Cairo: Government Press.) P.T. 100. [153]

Punjab Irrigation Research Institute. Report for the Year ending April 1936. Pp. iv+73+62 plates. (Lahore: Punjab Irrigation Research Institute.) [153]

Indian Forest Records (New Series). Vol. 2, No. 11: Entomological Investigations on the Spike Disease of Sandal (30 *Reduviidae* (Hemipt.)). By N. C. Chatterjee. Pp. ii+207–221. (Delhi: Manager of Publications.) 10 annas; 1s. [153]

Kungl. Svenska Vetenskapsakademien Handlingar. Serien 3, Band 16, No. 2: The Collection of Pteridophyta made in Hispaniola by E. L. Ekman 1917 and 1924–1930. By Carl Christensen. Pp. 93+20 plates. (Stockholm: Almqvist and Wiksells Boktryckeri A.-B.) [153]

India Meteorological Department. Scientific Notes, Vol. 7, No. 71: A Note on the Statistical Study of Rainfall in the Mysore State. By A. Ananthapadmanabha Rao. Pp. 21–33+2 plates. (Delhi: Manager of Publications.) 7 annas; 9d. [153]

Transactions of the Mining and Geological Institute of India. Vol. 32: Drilling Mud: its Manufacture and Testing. By P. Evans and A. Reid. Pp. 263+xxx+15 plates. (Calcutta: Mining and Geological Institute of India.) 12 rupees. [153]

Report of the Crohamhurst Observatory for the Year ending 31st December 1936. Pp. 10. (Beerwah, Qd.: Crohamhurst Observatory.) [163]

Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 12: Further Investigations on the Root-System of Sugarcane. By Dr. H. Evans. Pp. 34. (Port Louis: Government Printer.) [163]

U.S. Department of the Interior: Geological Survey. Bulletin 873: Geology and Mineral Resources of the Butler and Zellenople Quadrangles, Pennsylvania. By G. B. Richardson. Pp. v+93+8 plates. 45 cents. Bulletin 881: Spirit Leveling in Connecticut, 1922–35. By J. G. Staack. Pp. ii+65. 10 cents. Bulletin 886-A: Possibility of New Oil Pools in the Siliceous Lime and Bartlesville Sand in T.23 N., R.10 E., Osage County, Oklahoma. By N. Wood Bass, W. Reese Dillard and Jess H. Hengst. (Contributions to Economic Geology, 1937.) Pp. ii+4. Water-Supply Paper 785: Surface Water Supply of the United States, 1935. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. 283. 35 cents. (Washington, D.C.: Government Printing Office.) [163]

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 175: Powdery Mildew of Cucurbitaceae. By Dr. Amin Fikry. Pp. iii+25+24 plates. (Cairo: Government Press.) P.T. 7. [223]

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 12: List of Publications on the Botany of Indian Crops, Part 2, for the Period 1928–1932. Compiled by R. D. Bose. Pp. iv+198. (Delhi: Manager of Publications.) 3-6 rupees; 5s. 9d. [223]

Annual Report of the Agricultural Meteorology Branch, India Meteorological Department, for the Third Year ending 21st August 1935. Pp. 37. Supplements to the Report of the Agricultural Meteorology Branch, India Meteorological Department, for the Year ending 21st August 1935. Pp. iv+77. (Simla and New Delhi: Government of India Press.) [223]

Report of the Danish Biological Station to the Ministry of Agriculture and Fisheries, 41, 1936. Edited by Dr. H. Blegvad. Pp. 52. (Copenhagen: C. A. Reitzel.) [223]

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Fuel Briquetting. By R. A. Strong, E. Swartzman and E. J. Burrough. (No. 775.) Pp. iv+100+5 plates. (Ottawa: King's Printer.) 25 cents. [223]

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 145: Theoretical and Experimental Studies of Convective Circulation and its Relation to Land and Sea-Breezes. By Tatsu Kobayashi and Tatudōri Sasaki, with the assistance of Tadao Osanai. Pp. 67. (Tōkyō: Kōgyō Toshō Kabushiki Kaisha.) 70 sen. [223]

Department of Agriculture: Straits Settlements and Federated Malay States. Scientific Series, No. 19: Lac in Malaya. Part 2: An Account of Attempts to Propagate *Laccifer lacca* (Kerr) in Malaya. By N. C. E. Miller. Pp. ii+22+2 plates. (Kuala Lumpur: Department of Agriculture.) 50 cents. [223]

U.S. Department of the Interior: Office of Education. Bulletin, 1936, No. 8: Graduate Work in Engineering in Universities and Colleges in the United States. By Walton C. John and H. P. Hammond. Pp. xiii+113. 15 cents. Bulletin, 1936, No. 18–VI: Youth . . . Community Surveys. By Carl A. Jessen and H. Clifton Hutchins. Pp. x+97. 15 cents. Vocational Education Bulletin No. 188 (Agriculture Series No. 49): Young Men in Farming; a Study of Young Men to determine the Qualifications, Opportunities and Needs for Training in Farming, together with derived Guidance, Placement and Training Objectives. Pp. v+117. 15 cents. (Washington, D.C.: Government Printing Office.) [243]

U.S. Department of Agriculture. Leaflet No. 121: The Sweet Potato Weevil and how to Control It. By K. L. Cockerham. Pp. 6. (Washington, D.C.: Government Printing Office.) 5 cents. [243]