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KNOWLEDGE AND ACTION

IT would be easy from the recent debates in the House of Commons on the war situation or those in the House of Lords on the organization for joint planning to derive a false impression of national dissension at a time of crisis. The temper of the House of Commons debate ran high at times, and very clearly there are intrigues and some resentment against the Prime Minister and his advisers, accentuated to some extent by the Government's apparent yielding to party pressure and sectional interests over the Beveridge report on coal rationing. In the House of Commons, indeed, the debate was at a lower level than in the House of Lords, concentrating rather on the demand for a real Chief of Staffs, as distinct from the Minister of Defence, than on the more fundamental need for a Great General Staff and for combined commands wherever the Services work together.

Such an interpretation, however, would mistake the whole tone of the criticism which the Government, like any Government in the third year of war when a militant and aggressive spirit is widespread in the nation, must always face from a free people. It springs from the call for proof of action : that the industrial resources are fully mobilized for the final stages of the struggle, and that the Government will finally assert its authority against private interests. It is primarily a call for leadership of the highest order, and springs from the growing recognition that the development of our maximum effort is a matter of science and knowledge and not merely tradition, and that it involves scientific management and wise administration as well as a commanding character and original intellect.

From many quarters has come evidence of the outstanding importance of administration and management at the present time. This is strikingly illustrated in the account of the Western Electric Company researches which is included in a recently published report "Fatigue of Workers : its Relation to Industrial Production" by the Committee on Work in Industry of the U.S. National Research Council. Social conditions as a rule are far more potent in their effect on efficiency than physical conditions. The most urgent task is that of solving these problems of command, production and industrial organization with foresight as well as with pertinence and expedition. We need the really great administrator of Bagehot who "thinks not only of the day but of the morrow ; who is eager to extirpate every abuse and be on the watch for every improvement ; is on a level with the highest political thought of his time and persuades his age to be ruled according to it in policy and in laws".

These words of Bagehot's describe almost exactly the mood of the nation and the essence of its criticism—lack of foresight, of resolution in dealing with abuses, and of earnestness in seeking for improvement. Given, however, administration in this large sense, concerned with the far-seeing regulation of future conduct as well as with the limited management of the present, it can only be fully effective with the full support and co-operation of management as of people. The soundest policy may be frustrated by inefficient or incompetent management, and no administration can remain unchallenged which fails to use its powers to remove whatever obstacles lack of vision, incompetence or private interest may place in its path.

If, therefore, it is a profound mistake to judge that the nation is not united and that the Government does not still command the support of an overwhelming majority of the people, it would be a fatal error not to recognize that continued support depends, not on what has been done in the past, but on what is done now to strike against the enemy abroad or against vested or sectional interests at home. The debates, like the coal situation itself, hold a warning of dangers which may rapidly develop in the absence of resolute leadership.

While the Beveridge scheme still holds the field on the consumption side as a scientific method of providing prompt, fair and effective rationing, on the production side the industry has to demonstrate its inherent capacity to solve its problems. For a quarter of a century it has set its face against all plans for reorganization advanced by independent investigators to secure efficiency. To this Sir Richard Redmayne's recent book "Men, Mines and Memories" is a significant witness. Rationing of fuel, in fact, without reorganization of the coal industry, would be a disaster alike from the point of view of our war effort and of the peace to follow, when an efficiently organized coal industry will be no less imperative.

There can be no question as to the growing scale upon which both scientific methods and knowledge are being made available. Prof. A. V. Hill's inspiring Gustave Canet Memorial Lecture to the Junior Institution of Engineers on May 22 on "Scientific Research and Development in the Empire" (see p. 653 of this issue) and the recent appointment of Dr. C. G. Darwin as scientific adviser to the Army Council, however, will not dispel the uneasiness which recent events have aroused in the minds of scientific workers and others as to the will of the Government to use scientific knowledge to re-shape the nation's economy when the needs of victory so demand. The Government has, it is true, accepted the main recommendations of the Citrine Committee, but the exceptions made may well prove crucial. The main recommendation of the report is that the principle of devolution must be applied to the office of the Minister of Production: "Just as the Minister of Production is charged with the duty of concerting and supervising the activities of the supply Ministries at the centre, so there should be in each region a representative of the Ministry whose duty it should be to concert and supervise the activities of the Regional Controllers of the Supply Departments."

The core of the Citrine Committee's plan is thus to have regional directors of production with this task of supervision to ensure the maximum degree of co-ordination. The Government, however, has already rejected this recommendation, and there are to be regional controllers, each of whom will indeed be chairman in his region of the regional board and of its executive committee, but he will at most be *primus inter pares*. It will still be impossible for regional facilities to be fully pooled and utilized. It is, of course, a distinct gain that most, if not all the most important, regional organizations for specific matters will now be centralized, physically as well as administratively, under the regional boards. The proposals making the regional boards cognizant of all the contracts placed and all the work in progress in their areas so that they can keep constant watch over the flow of orders and deliveries and over the use of capacity are to be welcomed, but it should be noted that vital exceptions have been made by the Government to the recommendation that the independent organizations established by the Supply Ministries for capacity-finding should be merged in the regional organization.

The regional organization of the Admiralty is to be excluded even when it is concerned with non-shipyard work. The regional organization of the Controller General of Machine Tools is to be excluded; and owing to the limitations imposed on Mr. Lyttelton himself in the matter of labour, the regional controller of production will have no more than joint powers with the regional controller of the Ministry of Labour over the allocation of labour. Given the right type of man of wide industrial experience and local knowledge visualized by the Committee, the new system may indeed prove better able to control effectively the local allocation of resources, to marry capacity and requirements, so that no capacity is unused and no requirements are unfulfilled. It puts a strain on the human factor, however, that the Citrine Committee's own recommendations might avoid, and it is difficult to escape the conclusion that once again the Government has missed a great opportunity presented by an admirable report of an expert committee.

There is, indeed, much to ponder in this penetrating analysis of organization. The first principles are sometimes laid down with disconcerting frankness. The emphatic and unanimous opinion that an efficient regional organization is an essential element in the effective prosecution of the War is accompanied by the equally emphatic opinion that an essential pre-requisite for the effective functioning of any regional machinery of co-ordination is a properly articulated system of devolution of executive authority. There is a tribute to the organization of the Ministry of Labour and National Service, and the Committee considers that the same method of organization could and should be equally applied to the other factors of production. Indeed, the report suggests that had there been developed correspondingly effective machinery for the collection of information about manufacturing capacity, for placing contracts and sub-contracts and for dealing with progressive problems comparable with that under central control for dealing with the man-power problem with which we entered the War, not only would the task of the employment exchanges in redistributing skilled labour for the purpose of building up new production units with unskilled labour have been made easier, but also, with adequate supplies of raw materials, the tempo of production would have been accelerated without a corresponding increase in the demand for machine tools or floor space.

There are trenchant observations on the failure to give the existing regional boards the opportunity of playing a continuous and effective part in securing the fullest possible use of the manufacturing resources of Great Britain, on the neglect to consult the Central Joint Advisory Committee, on the delays which result from failure adequately to plan the distribution of work and on the wastefulness of the establishment of capacity clearing centres of their own by the Supply Ministries. The Committee's ideas on the functions of the Boards, on their constitution, on the district organization and on those of the National Production Advisory Council which it proposes, are as clear and as sound as their views on decentralization, and their observations and recommendations are further supported by evidence in the Seventh and Eighth Reports of the Select Committee on National Expenditure, which have appeared since the Citrine Committee commenced its investigations.

The failure to implement the proposals of an impartial or expert inquiry is indeed one of the fundamental reasons for public anxiety at the present time, in spite of growing appreciation of the magnitude and efficiency of much of the national effort, as reflected, for example, in the recent report on conditions in a royal ordnance factory made by a deputation from a local trades and labour council which had received complaints as to idle hours, idle machines and lack of sympathy between management and workers at the factory. The deputation of six which visited the factory with the permission of the Ministry of Supply concluded its report with the words: "If this factory is a fair sample of those being run by the Ministry of Supply, their greatest critic will have to go very far before he can find a concern run by a private enterprise to equal them in the provisions made for the comfort and convenience of the employees." Management and administration have indeed great achievements to their credit, but the national effort will only reach its maximum when the standards of the best obtain everywhere and the latest advances in technique and knowledge are applied with wisdom, with firmness and with understanding both of men and materials. How much yet remains to be done in this field by the establishment of closer relations between management and worker is indicated by the Western Electric researches already mentioned.

It is at this same point that the debate in the House of Lords on May 5 betrayed misgivings. On the question of the organization for joint planning and the issue of a Great General Staff or a Chief of Staff as advocated by Sir Edward Grigg, little that was new was advanced, but there were significant observations as to the place of the scientific and technical experts. Lord Denman, for example, urged that fuller use should be made of the services of scientific men and technical experts, and suggested a chain of technical authority from the Army Council down to the military units in the field. He was concerned about the utilization to the best advantage of our great scientific and technical assets. Lord Swinton again emphasized the essential part which the integration of science and strategy and operations in the Air Ministry has played in making the victory of our pilots possible. In his view the Sub-Committee of the Committee of Imperial Defence, on which sat the Chiefs of Staff of the three Services or their deputies, the directors of development and production in Production Ministries or the Service production branch and the scientific advisers formed an integral part of the Combined General Staff, and gave the scientific side both the status and the opportunity of playing their part to the full; that common meeting-ground no longer exists, and Lord Swinton held that no organization exists by which scientific men can play their part in framing strategy to-day.

Mr. Lyttelton, it is true, has already indicated his plans for meeting this need in regard to the production side, but the marriage of scientific with operational staffs and in framing strategy as well as tactics is more than ever necessary to-day. Lord Milne pointed to the difficulties which arose when the whole of the supply technical services were taken out of the hands of the Army and transferred to the Ministry of Supply. That the Army should have been incidentally deprived in this way of technical advisers in such a technical war is, of course, a serious matter, and Lord Milne's plea for some return of staff and for a technical staff to consider research, preferably a joint technical staff linking the experience and requirements of the War Office with the activity and possibilities of the Ministry of Supply, is most reasonable. The need will no doubt be met, to some extent, from the new corps of Royal Electrical and Mechanical Engineers.

Lord Hankey himself, like Lord Trenchard, lent powerful support to the plea for a joint technical staff as part of the Combined General Staff and for bringing scientific workers into the central control of the War—a matter which need not wait on the appointment of the Chief of the Joint General Staff for which Lord Hankey pressed. Lord Chatfield's reply on this point was unconvincing, like that of Lord Simon. Organization of scientific research is already fairly effectively co-ordinated in ways which Lord Hankey as well as Lord Chatfield has outlined on previous occasions. That, however, is not the point at issue. The vital question is that of securing that the immediate study of strategy and tactics by the General Staff is conducted with an awareness of the possibilities which technical and scientific advance have put in our hands. That cannot be done by Service chiefs in isolation from scientific workers, or without some real appreciation of the scientific and technical factors involved.

The fundamental problem is the perennial one of relating effectively knowledge and action, whether against the enemy abroad or against any private interest at home which stands in the way of the nation's purpose. It calls for the application of those basic principles of the Haldane Report on the Machinery of Government which have too often been overlooked in debate as in policy: the integration of the field of work and the separation of planning from administration. In those principles lies the clue to the solution of the fuel problem as of that of production or the planning of combined operations. The nation has no reason to doubt that we possess the resources of materials, of technical or scientific skill, of men and women and of staying power and character required for victory, or even that leadership of the requisite calibre cannot be found for whatever onerous co-ordinating posts may be necessary. There is, however, real concern at the moment, less at the quality of our leadership than as to its determination to use both its authority and resources. The simplest demonstration that the Government accepts the principle that nothing shall be left undone that serves the national purpose would dispel such concern, but such a demonstration is imperative. No longer can the nation be left in doubt as to whether suaveness of manner is merely a cloak for tenderness to sectional interests when the national purpose demands swift, resolute and courageous action.

R. W. WOOD OF BALTIMORE

Doctor Wood, Modern Wizard of the Laboratory

The Story of an American Small Boy who became the most Daring and Original Experimental Physicist of our Day—but never Grew Up. By William Seabrook. Pp. xiv+335+13 plates. (New York: Harcourt, Brace and Co., Inc., 1941.) 3.75 dollars.

FEW American scientfiic men can be better known in Great Britain than the subject of this biography. The author has been in close touch with him, and has had every opportunity of gaining authentic information. The book is a popular one, and, as is perhaps natural and inevitable, has less to say about Wood's scientific achievements in developing resonance radiation and resonance spectra than about his personal adventures in various scientific and semi-scientific fields such as the aviation of early days, thawing frozen pipes, war work and scientific detection of crime. We are left with the impression that, successful as he has been as an experimenter, he could have done equally well as a conjuror or a variety entertainer.

The choice among many interesting topics for comment is almost embarrassing. Wood had for years been interested in filters transparent to ultra-violet light but opaque to the visual. The nearest approach to this generally available before his time was dense cobalt glass, which was used in Stokes's original investigations on fluorescence, but which is very far from the ideal. Wood introduced the use of nitrosodimethyl aniline; but this, though it separates ultra-violet from blue much better than does cobalt glass, lets through a good deal of yellow. During the War of 1914–18 Wood gave his attention to the question again, and, arguing perhaps from the chemical analogy of cobalt and nickel, he tried a glass containing nickel oxide. This isolates the ultra-violet very satisfactorily, letting through no visual light, though of course it has the same limitation as ordinary glasses, that it stops wave-lengths shorter than λ 3000. This glass has many applications. One of them mentioned in the book is for the detection of secret writing by fluorescence. There is a very instructive incident told on p. 205. Wood was in Great Britain as a scientific-military officer and was being shown the secrets of the base censor's office. "What goes on in that cupboard?" he asked. It was too secret to be shown. "Ultra-violet light, I presume," said Wood. Eventually he was shown it. It was the old method used by Stokes in 1855, of cobalt glass to cut out the yellow and green from the source, and a yellow glass over the observer's eyes to cut out the blue. Wood happened to have a sample of his nickel glass in his pocket, and showed them how superior it was. Where could they get such glass? Answer: "Already in use at Portsmouth Dockyard; why have you not got them already?"

This kind of thing may well reduce scientific men who are called in to deal with war problems to despair. It was quite typical, and one would like to know whether in the interval of peace during 1918–39 anyone gave his mind to the question of how it was to be avoided in future. The answer would almost certainly be in the negative.

We are told how Wood took part in the investigations on the "spiritualistic" phenomena of Eusapia Palladino thirty years ago. He invented various ingenious methods of testing her, but does not seem to have had the opportunity to apply his methods satisfactorily. One of her phenomena was the bulging out of a curtain without obvious cause. Wood adheres definitely to the view that it was blown out by a current of air artificially produced. Readers of Sir J. J. Thomson's "Recollections" will find that he inclined to a quite different explanation. Eusapia was definitely caught in fraudulent manipulation by Dr. Hodgson and Mrs. Sidgwick, but it must be remembered that a paid medium has to 'deliver the goods' in order to earn a living; and if there really are genuine efforts, and if they will not come at pleasure, the temptation to imitate them fraudulently must be very strong. It is possible therefore to over-emphasize the unfavourable conclusions to be drawn from detected fraud. Some serious students of the subject still believe that genuine phenomena were, on occasion, produced by Eusapia, but, practically, their opinion can scarcely carry much weight.

This kind of investigation is difficult enough when we have only to attempt to gauge whether or not the paid professional mediums are deceiving the investigators. But if the investigators cannot be trusted not to deceive one another it indeed becomes almost hopeless. We are told of how Wood made use of some private knowledge which he happened to possess to deceive Dr. J. H. Hyslop and Sir Oliver Lodge. Hyslop had every reasonable ground for supposing that Wood could not have possessed this knowledge normally, but he happened to be wrong in so thinking, and Wood, pretending to be in a kind of dream state, intentionally led him to believe that it had been acquired in some supernormal way by telepathy. If this had been immediately afterwards confessed, and used to point a moral of the necessity for caution, it might pass. As it was not confessed, we do not think that it was justifiable to treat a brother scientist and a sincere searcher after truth in this way. Practical joking of this kind is a dangerous game, and may inflict grievous injury on the victim. For example, Paul Kammerer is said to have been driven to suicide because thoughtless students had deceived him by faked evidence for the inheritance of acquired characters. In any case, the incident reads oddly in a chapter entitled

"Debunker of Frauds". The boot seems rather to be on the other leg. The most favourable view is that Wood was on this occasion, as the title-page indicates, acting like a boy who has never grown up.

It is understood that Wood's energies have, of recent years, been largely devoted to the problem of ruling diffraction gratings which will throw most of the light into a single spectrum. In stellar spectroscopy there is no more important experimental problem than this one, and probably none better suited to our hero's peculiar talents. The need is always for more light, and the enormous sums spent on large telescopes are eloquent of this. But for many purposes it would be as good or better to double the amount of light thrown into a given spectrum as to double the area of the telescope objective; and, once we know how to do it, the cost would be incomparably less. So far, little is known in Great Britain of the details of Wood's methods, except that he makes his rulings on aluminized glass. We see in the bibliography of this book that a paper was due to appear in the *Astrophysical Journal* for December, 1941, but in fact no number appeared at all for that month. There are, if we understand rightly, hints of very large transmission gratings also.

We recommend the book as amusing reading, and are glad that a vivid personality has been recorded as a contribution to the history of science in our era.

Rayleigh.

EDUCATION AND NATURE

Truth and Fallacy in Educational Theory
By Charles D. Hardie. Pp. x+151. (Cambridge: At the University Press, 1942.) 6*s*. net.

Mr. C. D. Hardie's book is the kind of book which causes one to look backward, to look around, and then to look forward. He writes as a philosopher, and therefore as one engaged in an obstinate effort to think clearly. Though he does not express it in so many words, his real aim seems to be to show up the confusions in educational theory that have arisen from ambiguities in the use of the term 'Nature'.

As far back as the 1860's Herbert Spencer wrote his forceful and influential essays on education "according to Nature". He was consciously indebted to Pestalozzi, who in turn drew his inspiration from Rousseau. Speaking generally, we may say that writers of this type held that intellectual education should be based upon sense-impression, since that is the method of Nature, and that moral education should be based upon the discipline of consequences, that again being the method of Nature. Spencer waxes almost lyrical in praise of the blind forces of Nature, as against the meddlesome activities of parents, nurses and teachers. But during the closing decade of the century, there came to Great Britain from Germany, chiefly by way of America, the opposing influence of Herbart, who had no use for a theory of education which belittled instruction and guidance. For a child running down a steep declivity the intervention of the mother was just as much a part of Nature's plan as the pitiless operation of the law of gravity. Herbart's whole system exalted the province of parent and teacher, so much so indeed as to incur with justice the charge of over-direction. Hence the welcome accorded to the movement associated with the name of John Dewey. According to him, the way appointed by Nature, if we only understood her, was that of letting the child take the lead, not the teacher. This principle, embodied in the so-called project method, has in some hands been carried so far as to sacrifice what is best in the traditional 'grind', and to provoke a protest from Dewey himself. That is where our 'progressive' teachers now stand.

In his first three chapters Mr. Hardie passes in critical review each of the movements above described. Much of his criticism has, of course, been anticipated by previous writers, but the modern ring in his remarks is refreshing, as when he shows that the laws of arithmetic have nothing to do with little operations with beads and beans, that it is far from being 'unscientific' to accept results on authority, and that Herbart's conception of many-sided interest—for which Mr. Maxwell Garnett would substitute a single wide interest—has much to say for itself if understood in a deeper sense than that of merely "making things interesting".

Proceeding from these discussions of ambiguities and fallacies, the author in his fourth chapter sets down what he conceives to be the basis on which an educational theory should be built. Recalling many definitions of education, showing some agreement and some important differences, he asks whether there is one that is right and all the rest wrong. In the course of the chapter there are valuable discussions of the elusive conception of instinct, of the still more elusive conception of intelligence, of the transfer of training, of heredity and its importance (or otherwise) for education, and lastly of the conception of value. This final topic leads the author back to his question whether there is one definition of education that is right and all the rest wrong. He ends with a plea for tolerance, for no one of them is right and no one wrong.

The reviewer feels moved to add that the book makes unnecessarily difficult reading, partly because of the inherent obscurities of the subject, and partly through causes that seem to him remediable.

T. Raymont.

FAULTING AND DYKE FORMATION

The Dynamics of Faulting and Dyke Formation: with Applications to Britain
By Dr. E. M. Anderson. Pp. xii+191. (Edinburgh and London: Oliver and Boyd, 1942.) 15*s*. net.

This book can be warmly recommended to geologists, who will read it with great interest and profit. The theory of principal stresses had long been applied by engineers to explain fractures in materials, but it was the author who first applied it in explanation of the main types of rock fractures or faults well known to geologists. From field experience these had been classified into three main types called strike faults, dip faults and oblique faults which conformed to neither of these directions. With increasing knowledge it was found that the majority of those in the first class were overthrusts while those of the second class were mainly normal faults. It was only later that the oblique faults were better understood; many of these have now been proved to be associated with some horizontal movement parallel to the earth's surface, and they have been called tear faults, transcurrent faults (the name favoured by the author), and a variety of other names.

In 1905 Anderson, by applying the theory of principal stresses in conjunction with Navier's principle of internal resistance to shearing proportional to the normal stress, succeeded in elucidating the general stress conditions that might give rise to these three types of fractures and showed that faults in general conformed to the deductions from the theory. Since then he has applied the same principles in explanation of intrusions of cone-sheets or inclined sheets characteristic of the Tertiary Igneous province of the Inner Hebrides. In the book under notice the latter are excluded, but dykes and sills are brought within the same principles and some interesting deductions are made regarding their possible mutual relations, which are discussed in some detail.

It is considered that fault fractures are in general produced by shearing stresses, whereas in the emplacement of dykes the fractures are the result of tension or at least of pressures across the trend of the dyke substantially less than the pressure of the magma at the point of rupture.

The principal stress theory as applied to faulting is now fairly well known among geologists, and some years ago the Geological Society of London organized a joint meeting with the Royal Astronomical Society (Geophysical Discussion) at which its relation to the formation of faults and other fractures was discussed. Its re-statement and the special applications dealt with in this book will, however, be genuinely welcomed.

Several areas in Great Britain are described, and the general stress conditions which are revealed by their fault systems are deduced. Attention is directed to those regions where the faulting is either of Caledonian or Armonian age but mainly the latter, since faulting of that age has been more closely studied on account of its effects in coal mining. The investigation is therefore only a beginning, but it is likely that its presentation in a form which can be easily understood will result in a closer study by geologists of the stress conditions that prevailed in other areas and of other periods, and thus help to build up the tectonic history of the British Isles and other regions throughout the ages.

In the presentation of the theory in 1905 the effects of superposing shear stresses on the principal stresses were suggested. Its omission in this book leads the author into difficulties in interpreting certain faults in South Wales and elsewhere. D. W. Phillips has shown the importance of taking these into account in explaining induced cleavage produced near a working coal face.

The author perpetuates the mathematical fiction of tension in the earth's crust, which is difficult to appreciate in view of the fact that fault fractures must, in general, have their origin at a depth where high pressures must prevail in every direction. Tension is apparently regarded in the same way as a relief of pressure. It is difficult to conceive of a stress deep in the earth's crust changing in a short interval of time from a pressure to a tension in the same direction but mathematically a relief of pressure is perhaps regarded as a tension superposed on the pre-existing pressure

In general, if one horizontal stress at some depth is increased, an element of the crust is shortened in the direction in which it is applied and lengthened in all directions at right angles, the amount of extension being given by Poisson's ratio. The extension is, however, opposed by the resistance of adjoining elements, and in this sense an increase of pressure in one horizontal direction brings into play a pressure in directions at right angles which is in a certain ratio to the increase of applied pressure.

The author considers increase and relief of pressure by reference to an imaginary 'standard state' where the horizontal pressures are approximately equal to the vertical load of the column of rock. This conception tends unduly to divorce the phase of faulting from preceding phases (such as folding) during which the conditions have long been different from the standard state.

It would take too long to follow the author in his detailed analysis of various areas of faulting. A study of the post-Carboniferous faulting leads to the conclusion that the directions of stress during the formation of these faults remained remarkably similar over a large part of Great Britain. In particular examples, however, sufficient allowance is not made for local variations in the stresses which controlled the directions of certain faults. One example occurs in the South Wales coalfields and South Pembrokeshire. In the latter area strike faults and tear faults occur in association with one another and with folding. In the main coalfield there is also some folding, but the dominant structures are the 'north-north-west' faults. The author is inclined to group these with the north-north-west tear faults of South Pembrokeshire with which, however, they have little in common. The fold axes of the coalfield change gradually in direction from east-north-east in the east to about east-west in the west, and taking these as an indication of the direction of the greatest horizontal stress, the faults lie very near that direction and thus conform to the stress conditions of normal faults, which in fact they are.

In the same field there are complex belts called 'disturbances', of which one near the Tawe Valley is but an example of many parallel structures; these are generally believed to be younger than the north-north-west faults. They are, however, probably a reflexion in the Palæozoic rocks of deep-seated fractures in the pre-Cambrian floor which are liable to move with any great increase of stress in the area. Two faults are deflected in crossing the Tawe disturbance, as shown in Fig. 21. If, however, a counter-clockwise shear in the direction of this disturbance is superimposed on the principal stresses of the adjoining region, the deflection of the two faults is explained.

Another great fault belonging to the same general system is the Church Stretton fault, which is now under investigation for a great part of its length. This fault belt is a symptom of deep-seated conditions which may have caused local modifications in the general stress distribution that prevailed outside the belt at various times.

There is an interesting discussion of the conditions necessary for the production of dykes and sills and for the passage occasionally observed of one into the other.

The reader is cautioned against accepting the statement of enormous horizontal displacement along the line of the Great Glen fault until more critical evidence is produced than has hitherto been made known.

O. T. JONES.

SCIENTIFIC RESEARCH AND DEVELOPMENT IN THE EMPIRE*

By PROF. A. V. HILL, O.B.E., F.R.S., M.P.

Canet

IT might seem a bitter irony of fate that a lecture should be given in memory of a great French engineer, in the field of artillery, who lived so long in England and had so many intimate connexions here, at a time when a Government of traitors in France is actively aiding the common enemy against her ally. Were Jean Baptiste Gustave Adolphe Canet alive to-day, we know very well where his heart would be. "It would be impossible", it has been said of Canet, "to record his innumerable acts of consideration and regard for the Junior Institution of Engineers", of which he was an honorary member, a vice-president, and president in the year he died. It would be impossible for an Englishman who has been intimate with Frenchmen of his kind not to believe that France will rise again, purged by her misfortunes, to better things. The world cannot do without a nation which can produce men of his genius, whether for engineering, philanthropy or friendship.

Empire Science

France, however, does not come very far into the story of scientific research and development in the Empire, which I have to tell to-day, though it is true that the Dominion of Canada was originally French, that a significant part of its culture is still French, that scientific men and engineers of French origin take an important part in Canada's life, and that Henri Laugier, head until the fall of France of the French equivalent of the Department of Scientific and Industrial Research, is busily engaged there now in work devoted to our common cause. Predominant as may be, so far, the Anglo-Saxon part in Empire science, significant contributions have been and are being made by almost every national group within it. It is a common enterprise of all the peoples of the Empire, biased locally in direction by local requirements and facilities, but carried on everywhere in the same spirit, by the same methods and with the same standards of accuracy and objectivity.

The chief object of this lecture will be to try to indicate how closer and more effective scientific co-operation within the Empire can be obtained.

Imperial Collaboration in War Research

In the early days of the War my colleague and co-secretary of the Royal Society, Prof. A. C. Egerton, and I, convinced of the enormous prospective advantage to our common war effort of close consultation with organized science in the Dominions, discussed the matter with Sir William Bragg, then president of the Royal Society, who, from his twenty-two years at Adelaide, was very well acquainted with science in Australia, and had close connexions with scientific men in the other countries of the Empire.

Fortunately, Dr. R. W. Boyle, of the National Research Council of Canada, was in London at the time—having escaped from Poland, where he had been on holiday when war broke out—and discussions with him then helped to bring our plans to later fruition. That winter also, Dr. Madsen came to England from Australia to obtain information about certain important scientific and technical developments here which must be of vital importance now, with Australia in the front line of battle. Then early in 1940 the opportunity occurred of going for a period, on behalf of the Air Ministry, to the British Embassy in Washington; an opportunity which I seized, seeing in it the means of making arrangements for scientific collaboration, on the one part between Britain and the United States (not yet in the War, but warmly sympathetic), on the other part between Canada and the "old country", as they affectionately say. There was no difficulty of any kind in Canada —only anxiety to see the thing put through—and plans were accordingly made. In Washington one was confidently assured that the President would instantly respond to an approach from the British Government—which, in fact, he did when the approach was ultimately made.

In August 1940, the Canadian plan was started off by Prof. R. H. Fowler going to Ottawa to act as scientific liaison officer with the National Research Council, and to develop an informal connexion with scientific men in the United States. A little earlier the National Defense Research Committee had been formed in Washington, with Dr. V. Bush as chairman. Finally, in the autumn of 1940, Sir Henry Tizard took a mission to Canada and the United States. No words can overstress the importance of what was achieved by that mission and by Fowler's strenuous efforts.

In the meantime another plan we had had at the Royal Society, since the summer of 1938, also reached shape and fruition, and the Scientific Advisory Committee of the War Cabinet was formed—most fortunately under the chairmanship of Lord Hankey.

It is difficult now to remember good-humouredly the further unnecessary difficulties which arose, but finally an office of the National Defense Research Committee was established at the American Embassy in London and a British Central Scientific Office in Washington; while representatives of Canadian and Australian science were appointed to the offices of their High Commissioners in London. To these a continual flow of scientific men and engineers, engaged in various projects, has come; while in the persons of Mr. Nevill Wright, of the New Zealand office, and of Colonel B. F. J. Schonland, of South Africa, representatives of those Dominions also have been available in our counsels. Attempts have been made, but unsuccessfully so far, to establish similar arrangements with Indian science.

Speed in Travel and Transmission

The contributions which have been made already by this organized collaboration have been very important, and now that it is running sweetly greater results still will accrue. It is quite impossible to achieve more than a small fraction of what is needed merely by correspondence and by the circulation of reports, drawings and specifications: personal contact and personal initiative are needed also, for which it is necessary to provide, on the one hand permanent or semi-permanent scientific liaison officers in the various centres—as has now been done—on the other, means of rapid transport for short visits by experts either way. The rapid transfer also of correspondence, documents and drawings, and of small samples, is essential—for the former, given air transport, the

* Substance of the ninth quadrennial Gustave Canet Memorial Lecture of the Junior Institution of Engineers on May 22.

microfilm method, which is rapidly coming into its own, is of very special advantage.

Great difficulty is still experienced from slowness of travel and transmission of scientific people and information. At present official communication with the United States may take anything from two to six weeks. It is too slow. With Australia and New Zealand and South Africa now it is essential that safe and rapid transfer of information should be possible.

The Future

The presence in London of so many representatives of science in the Empire, in close and frequent contact with their colleagues at home by visits and correspondence, offered the opportunity of instituting a discussion of joint problems, quite apart from those immediately connected with the War. The persons concerned would naturally be very busy with urgent work, but the question of future scientific collaboration within the Empire, and, arising from that, with the United States, was so important that a general consideration of it at occasional informal meetings would be possible and fruitful. The two main objects of discussion might be, first, emergency problems of the immediate post-war era, and, secondly, the possibility of making the most of our common scientific resources and heritage for improving both scientific knowledge itself and the life of the peoples of the Empire.

With this in view, the officers of the Royal Society called a conference in October 1941 of the representatives of the countries of the Empire, together with the officers of the Society, the secretaries of the Agricultural Research Council, the Medical Research Council, and the Department of Scientific and Industrial Research, and others. The president, Sir Henry Dale, in opening the conference, mentioned the ideal of continued collaboration in time of peace, saying that the material structure of society depends on science, and that if reconstruction was to be tackled on a properly international scale science must once more become an international activity. A first step towards this could probably best be taken on the initiative of scientific men of the British Empire and the United States together ; for example, the International Scientific Unions would have to be started again, if possible on better lines. Sir John Madsen, from Australia, felt sure that great interest would be taken by the other Governments of the Empire in the view of the United Kingdom Government in this matter ; he suggested that an extension of facilities for meeting and working with their colleagues elsewhere would greatly improve collaboration, and that the first activity of a committee to be set up, following the conference, might be to explore the facilities at present available and the means of extending them. General A. McNaughton, as president of the National Research Council of Canada, offered every possible help and support for the objects of the conference, and considered that the interchange referred to should occur, not only between universities, but also between industrial and Government laboratories in the different countries, including if possible the United States : he did not believe that if scientific people were convinced that this interchange was necessary, financial difficulties need stand in the way. Sir Edward Appleton, secretary of the Department of Scientific and Industrial Research, hoped that permanent liaison officers would be maintained in scientific and technical matters in peace-time as well as war. Sir Henry Tizard foresaw financial stringency as regards interchange for educational purposes, as distinguished from specific research, but urged that exchange would be particularly valuable between the universities of the Empire during undergraduate years, especially in applied science.

Lord Hankey welcomed the calling of the conference and said he felt sure that during the exploratory work proposed to be undertaken the inquiry would branch out and important new points of interest emerge. He referred to the advantage of having a scientific advisory committee with a Cabinet Minister as chairman, to bring science into direct contact with the centre of government. If in each country of the Empire the scientific organization was thus arranged, there would grow up gradually an official appreciation of science, since from time to time, as ministries changed, one Cabinet Minister after another would be taking a special interest in science. Colonel Schonland (South Africa) urged the importance of considering the scientific needs and possibilities of Africa as a unit ; and he added in a later letter to me : "It is not a question of money at all, but of brains and sound organization."

A number of others took part in the discussion, and it was recognized that later on it would be most desirable if possible to secure close collaboration with official and unofficial science in the United States ; all were agreed that popular lecture tours did not at all fulfil the purpose in mind ; special reference was made to co-operative work in agriculture ; and the conference then appointed a committee to look into the various proposals made.

I have described the discussion at this conference in some detail because of the great importance of several of the points raised, because it may be the beginning of an important movement towards closer scientific collaboration, and because many in other parts of the world may be glad to know of what is going on. It is not easy in times like these to get much more work out of busy people, but the committee appointed (which, in addition to representatives of the Royal Society and of the Dominions and India, has included Sir David Chadwick, secretary of the Imperial Agricultural Bureaux) has met already seven times ; and owing to the initiative of its secretary, Dr. Alexander King, scientific liaison officer in the Ministry of Supply, much information has been collected and discussed on science in the Empire and on facilities for interchange in advanced study and research. The representatives of a variety of interests have been interviewed, including the research associations, the Universities Bureau of the British Empire, the 1851 Exhibition Studentships, the Leverhulme Fellowships and the British Council ; and a variety of suggestions have been made and followed up. All this will serve as the basis for further exploration and planning, and it is intended next to proceed to the discussion of concrete proposals to improve the machinery of collaboration.

The Colonies

In all this discussion there has been no specific reference so far to the Colonies, only to the Dominions and India. The scientific problems and the possibilities of scientific development in the Colonies, Protectorates and Mandated Territories are, however, of great importance, and considerable attention has, in fact, been devoted to them for some time. In 1927, for example, the Colonial Office formed a Colonial

Medical Research Committee, a mixed body of administrators and scientific members. Little, however, was done, but in 1936 the Colonial Office asked the Medical Research Council to supervise research in tropical disease, a project which this time seemed likely to be highly successful, but was interrupted by the War. Under the Colonial Development and Welfare Act, 1940, two funds have now been created, one of £5,000,000 a year for ten years for Colonial development and welfare generally, one of £500,000 a year without time limit for Colonial research. A director of a proposed Colonial Products Research Institute, it is hoped, will shortly be appointed; the products in question are those of biological origin. A Colonial Research Advisory Committee is to be set up under the chairmanship of Lord Hailey, which will not only advise on the expenditure of £500,000 per annum, but also will "advise upon and co-ordinate the whole range of research in Colonial studies".

The Imperial Agricultural Bureaux, founded in 1929, are concerned with agricultural matters in the Colonies as well as in all the other countries of the Empire. The Imperial Institute, founded in 1887, has five main departments, dealing with the commercial, industrial and educational interests of the Empire, particularly in relation to raw materials, to research upon them and to the development of their use and supply; minerals, plant and animal products, exhibition galleries, intelligence, statistics, library and laboratories are among its many activities. The Institute has many difficulties to contend with, not least the fact that with its enormous field of interest its annual budget is only £48,000, less than 1*d*. per square mile of the Empire whose natural resources it surveys, less than 3*d*. per square mile if calculated for the area of the Colonies alone!

An Africa Research Council

One of the suggestions made to the British Commonwealth Science Committee, to which I have referred, is that for the purposes of scientific research and development Africa might be treated as a separate unit, the work being a joint concern of the scientific organizations of the United Kingdom on the one hand and of the Union of South Africa on the other. Among the subjects to be treated, for which Africa as a whole has special needs and opportunities, might be tropical diseases, social anthropology and race relations, native languages, ethnology, geology, geophysics and meteorology.

The formation of an Africa Research Council, a joint interest both of governments and private benefactors and individuals, as so many of the best of our British institutions are, might lead to developments of the kind required for specifically African problems. There is no other region in the world in which the same variety of researches is needed, all to some degree for geographical and political reasons inter-related; if the different elements of this variety could be treated each as part of the whole scientific problem of Africa, and made to fit into the other elements, the results might be much more satisfactory and more far-reaching in importance than if all were studied separately according to subject and locality. A good example of the need for such an Africa Research Council is shown by the failure, before the War, to get a badly needed geodetic survey of Africa started, because there was no body in existence to father it.

It is clear that a scheme of this kind must wait for better times: it would involve the setting up of a central office and council, the collection and allocation of funds, the distribution of work and interests between it and other agencies, and the foundation of new or the development of existing research institutes, in Great Britain or in various parts of Africa. In view, however, of the obvious advantages it might have, it may be well to throw it now into the arena of discussion, so that on one hand it may be thought about, on the other so that no action may be taken in the meantime which might make it in the future more difficult to realize.

Existing Scientific Agencies in the Dominions and India

The scientific organization of the Dominions and of India is so highly developed, in universities and research institutions, in industry and under Government auspices, that no account of it, valuable as one would be, could be given in a lecture. The National Research Council of Canada is the equivalent, roughly, of the Department of Scientific and Industrial Research and the Medical Research Council in Great Britain, and of the research departments in the Service and Supply Ministries. It has great resources and a magnificent record, particularly in the present War. In Australia, the Council for Scientific and Industrial Research is the approximate equivalent of our Department of Scientific and Industrial Research and under the able leadership of Sir David Rivett it has made very important contributions both in peace-time and for the defence of Australia in the last three years. In South Africa the National Research Council, with advisory functions, and the National Research Board, with administrative functions, together with the South African Institute for Medical Research, take a prominent part in scientific developments in the Union. In New Zealand the Scientific and Industrial Research Department plays an analogous role. In India, the Board of Scientific and Industrial Research, under the able directorship of Sir Shanti Swarupa Bhatnagar, has taken a very active part in mobilizing the scientific and technical resources of India since its foundation in 1940; the Survey of India, the Zoological Survey, the Botanical Survey and the Geological Survey, the Indian Science Congress and the Indian Research Fund Association (medical) all have obvious and important tasks to fulfil.

This is merely a selection for purposes of illustration; Government agencies, universities, and private benefactions are responsible for innumerable others: in education and research; in application to defence, to industry and transport and to medicine and public health; in agriculture; for improving knowledge on one hand and the life of the people on the other. In each of these countries science and the scientific outlook, research and its application, make up a great and living organism. No doubt in each of them much remains to be done, as it does in Great Britain; but what is chiefly needed, and what will help beyond any other single factor in forwarding the promotion of science itself and its application to the public welfare is closer contact, more intimate knowledge, quicker and more frequent communication, a better intelligence and information service, easier exchange, between the several living parts of the whole living organism of science spread across the Empire, and—I should like to add—the United States.

Freedom of Research

I have talked a good deal about co-operation and collaboration, but not—you may have noticed—about co-ordination. Science is a free growth, and, as Sir David Chadwick recently wrote in a note to the British Commonwealth Science Committee: "much of the most valuable research must be free . . . To many who rightly prize that characteristic of research, the word 'co-ordination' denotes 'sinning against the Holy Ghost'. . . . One must bear in mind that the countries in the British Commonwealth have developed on different lines. These lines may meet in the end, but their starting points have been poles asunder."

This warning must be remembered. Co-ordination is necessary, within limits, to help to guide research into profitable channels and lest waste, overlap or its converse may occur; but in dealing with a group of proud and independent nations, however friendly and co-operative, we and they must all beware of attempting to introduce a degree of direction, authority or control which many will certainly resent. The Imperial Agricultural Bureaux represent an ideal of equal partnership in the co-operative dissemination of information on research. There is no reason why similar collaboration should not be built up about similar bureaux in other scientific subjects, or, for example, around the libraries and information services of the industrial research associations, the Imperial Institute, or other similar bodies in Britain or the Dominions. London need not necessarily be the focus for all. Co-ordination will then come naturally with increase of knowledge, contact and information. Co-operative research is a living, growing organism; it must be carefully tended, not just pushed into a mechanical framework planned from outside.

We hear a good deal about planning, and planning of scientific research we must certainly have. An Africa Research Council, for example, if it were to be set up, would require a deal of planning. Freedom, on the other hand, is the material and moral basis of the British Commonwealth, and requires explicit recognition in all we do or say. In some way planning and freedom must be combined. There is in this, as in most human affairs, an optimum mixture, the right proportions of which we must seek and find. This optimum must be aimed at, here in Britain, in the action and reaction of free science and free initiative with science and initiative provided by the State. It must be aimed at independently, perhaps with a different final mixture appropriate to their conditions, in each of the countries of the Empire; and it must be sought in the freely accepted co-ordination of the scientific activities of the different parts of the whole Commonwealth.

My own faith is that improvement in knowledge, contact, communication, familiarity between the scientific people of the Empire—and of the United States—will allow that co-ordination quietly to be achieved, the planning to be successfully undertaken, without any violation of the freedom on which we all set so great store, about which we are all so sensitive. It comes back again, therefore, to quickness, ease and facility of travel, transport and communication—things which engineers, in one way or another, must provide. For I believe that scientific people—and engineers—are on the whole rather more reasonable and practical—if not very much—than other folk, and that when we get to know each other by working together on a common job, we are generally ready to appreciate and understand the other fellow's difficulties and virtues and his point of view. The common job exists obviously enough in the scientific development of the Empire, for the improvement, as I repeat, of knowledge and of the life of its people: the important thing therefore is to improve the methods and technique of getting down to it together.

FAMILY ALLOWANCES

By D. CARADOG JONES
University of Liverpool

THE subject of family allowances—assistance given in cash rather than in kind, to meet the cost of maintaining children during the period of their dependency—bids fair to become a live political issue. It is now nearly twenty years since Miss Eleanor Rathbone's much-debated book, "The Disinherited Family", was published, wherein she made a powerful and piquant plea for the introduction into Great Britain of some system of communal payment for the important task of rearing children. Other countries had seized the opportunity presented by the War of 1914–18 to slip in the thin edge of the wedge and the breach thus made was afterwards widened, but Great Britain allowed that chance to pass.

It may seem odd that a time of war should be considered appropriate even for the discussion of such a subject. There are several reasons to account for it. When things are upside down, people are more ready to listen to revolutionary proposals. By grafting on to the normal bargaining process for settling wages a scheme of children's allowances, the needs of the family are taken into account as well as the skill and merit of the worker. To accomplish this would clearly be difficult unless prices are rising, and they invariably do rise during wars; and if wages are to keep step with the cost of living, there is much to be said for a sliding scale graduated according to the number of mouths to be fed. The payment of war-time separation allowances encourages, too, a widespread habit of expecting the weekly income to conform to the size of family. Moreover, under war conditions, the unmarried young man, if left to earn good money by making munitions instead of being obliged to serve in the Forces, would be unlikely to wish to attract critical attention by complaining if his pay does not rise in the same proportion as that of the man with a family.

Trades union leaders in Great Britain have in the past been either antagonistic or only lukewarm in their attitude towards family allowances, largely from a fear that they might be used to depress their standard of living. In countries such as France and Belgium there was the same fear, but it did not persist in any marked degree after the introduction of a compulsory State system covering a large proportion of the employed population. Under the type of scheme favoured by these countries, the allowances were financed by equalization funds, to which contributions were made by all the employers engaged in a specified industry or resident in a defined region. The sum put into the pool by each employer was proportional to the number of his workers or to his total wages bill. This simple device overcame the difficulty that some firms might otherwise have been tempted to employ only single men or men with very small families.

Advantages Claimed

Although the British Government may be presumed still to maintain an open mind as to the wisdom of introducing family allowances, a step forward has now been taken by the issue of an official memorandum on the subject (Parliamentary Paper, Cmd. 6354. London : H.M. Stationery Office. 2*d*. net) following a deputation of members of Parliament which the Chancellor of the Exchequer received in June of last year.

Advocates urge the disadvantage under present conditions, when everything possible should be done to avoid inflation, of meeting the rise in the cost of living by a flat increase in wages which puts extra money into the pockets of many people who do not need it. Any additional sum that can be spared towards wages, if distributed in the form of family allowances, would go, they say, some way to prevent malnutrition in households containing several small children. There is also the familiar claim that family allowances may arrest the decline in effective fertility. On this point the evidence derived from the experience of France and Belgium is not very conclusive, according to D. V. Glass, who has made a careful examination of the material. In his "Population Policies and Movements", published early in 1940, he says (p. 202) : "it is evident that they have not been influential enough to cause a rise in fertility, or even to stabilise fertility at its already low level of five or ten years ago. On the other hand, it is probably true that the family allowance system in France has helped to reduce infant mortality, and it is likely that this has also been the case in Belgium."

When families are not far from the border-line of poverty, there is no doubt that the advent of babies aggravates their economic condition, which inevitably reacts on the health and nutrition of all the members of the household. Evidence of the appreciably higher incidence of poverty among children than in the general population was obtained in the course of three social surveys, namely London, Merseyside and York. It is evident, therefore, that to subsidize the maintenance of children should be one profitable way of attacking the problem of poverty. But, while agreeing to this, it is still possible to hold the view that it might be wiser to give the subsidy in kind—better provision of infant welfare services, school dinners, improved housing, or some other form of social assistance—rather than in the form of a cash allowance to the parents, who might be tempted not to spend it on the children.

Contributory and Non-Contributory

The main arguments for and against family allowances are summarized in the Government White Paper without discussion. The cost is then estimated on various alternative assumptions. Thus, an allowance might be paid in respect of every child in the family ; it might be paid only in respect of the second and subsequent children ; or it might be paid only in respect of the third and subsequent children. Again, the scheme might apply to all parents, or it might be limited to parents below an agreed level of income, or to parents who are already subject to compulsory national insurance. The advantages and disadvantages of these various alternatives are briefly examined in the memorandum. Other equally important questions arise for consideration. Should the scheme be paid for by the State, the employers, the parents of the beneficiaries, or by some combination of these three parties on the principle adopted for national insurance purposes ? Finally, if the scheme is to be contributory, should it be also compulsory ?

Let us start with a contributory scheme. It is estimated that, in order to provide a flat-rate allowance of 5*s*. a week for each child of parents in insurable employment, the child to be less than fifteen years of age unless still receiving full-time education, the weekly contribution which would be required of every employed person (other than juveniles presumably) would amount to 2*s*. 8*d*. a week. As a matter of practical administration, the scheme would in this case no doubt be fitted on to the existing contributory pensions scheme, and the contribution conditions would be the same for both ; in other words, the State, the employer, and the worker would each contribute a share of the total estimated cost. It is further assumed that full contributions would be paid into the pool in respect of members of the armed forces, that equal contributions would be paid in respect of men and women, and that parents would continue these payments even when in receipt of benefit. The last-mentioned assumption means in effect that the nominal weekly allowance of 5*s*. for the parent with one child would be reduced to 2*s*. 4*d*.

No allowance has been made in this estimate for the cost of administration and, in view of the relatively small net benefit available, it would seem that a non-contributory scheme—though more costly to the public in general—might give a better return for the labour and expense incurred. We pass on therefore to consider a scheme where the whole expense would be borne by the Exchequer.

The estimated gross cost of a non-contributory scheme giving allowances at 5*s*. a week in respect of each child as before is £132 million a year. If the first eligible child in each family were excluded from benefit, the gross estimated cost would fall to £58 million a year. These calculations are made on the assumption that the allowances would be available for all classes of the population irrespective of their incomes. Additional estimates have been made, however, on two different assumptions : (*a*) that the benefits would only be available to parents with incomes of £260 a year or less ; and (*b*) that the benefits would only be available to parents already compulsorily insured for contributory pensions or, if not so insured, whose incomes amount to not more than £420 a year.

Clearly, the administration of the first of these two alternative schemes would involve a means test and for that reason it might not be very popular. The second scheme would be much easier to administer, because the bulk of the families eligible for benefit are already dealt with for national insurance purposes. Confining our attention accordingly to the (*b*) scheme, it is estimated that the gross cost of providing 5s. a week for every eligible child in the family would be £124 million a year. If the first eligible child were excluded from benefit, the gross annual cost would be reduced to £55 million.

These are the gross estimates, but the actual net cost under each head would be rather less, because there would be some saving of expenditure on children's benefits provided by existing social services of one kind or another. These benefits would naturally be revised to avoid duplication with family allowances. For example, where the needs of the family are assessed for the determination of benefits, as in making grants of unemployment assistance, family allowances would have to be taken into account.

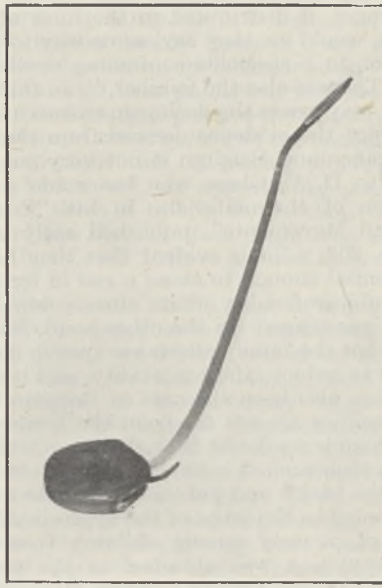
It is impossible to estimate all such savings with precision. In so far as an estimate can be made, the total sum saved is put at £7 million a year for a scheme covering all eligible children, and at £3 million for a scheme covering all eligible children except the first in each family. These same figures are used whether the benefits are to be available for all parents or confined to a particular class. It follows that for a universal scheme, covering all parents, the estimated net cost under existing conditions to provide a flat-rate allowance of 5*s*. for every child less than fifteen years old, or over that age if still receiving full-time education, would be £125 million a year ; and to provide allowances for all except the first eligible child in each family the net cost would be £55 million a year. The corresponding figures for a scheme confined in the main to the classes in the population which are already subject to compulsory national insurance would be £117 million and £52 million.

It would be unfortunate if we missed this opportunity of introducing a long-overdue reform. It might be well to start modestly with a scheme covering every eligible child except the first in each family, but to make it universally applicable since, if we can accept the above figures as reasonably accurate, the difference in cost between the universal and the limited scheme is relatively so slight. This would be of help to all except the smallest families. Eugenists would like also to give additional encouragement to families with the best heredity, but to discover the 'best' in this sense and to define it for administrative purposes would be difficult.

RECENT WORK ON GERMINATION

OPENING a discussion on seed germination held at the Linnean Society on May 14, Dr. M. A. H. Tincker, of the Royal Horticultural Society's Gardens, Wisley, read a paper dealing with the physiology of germination and incorporating some hitherto unpublished data of germination studies made at Wisley. The importance of low-temperature storage with low relative humidity tested in the United States was illustrated by common vegetable seeds including onion, carrot, leek and tomato. The response of seeds or achenes to various 'stratification' periods and temperatures so fully worked out at the Boyce Thompson Institute was also brought under review. With a number of lilies the seedling roots may grow but the shoots of certain species frequently do not appear for a year or more; while a higher temperature favours root growth, the dormancy of the epicotyl may be terminated by exposure to lower temperatures for a month or two. The seeds of further species of Primula have been shown to be light sensitive. Vernalization studies made at the Imperial College, in which very small embryos may grow into large plants almost as rapidly as normal grain, have an important bearing upon the question of small and large seed. The conditions favourable to the growth of small embryos in Fraxinus were mentioned, as was the widely different behaviour of the acorns of different oak species in regard to their after-ripening requirements in contrast to their similarity in respiration during winter. The interesting artificial methods used in Java of division of young, valuable seedlings of rubber at an early stage of germination to give a greater number of plants were described.

Mr. T. Hay referred to the germination of Emmenanthe (whispering bells) in soil which has been heated. *Romneya coulteri* also germinated better in heated soil. He stated that *Grevillea robusta* seed when placed in soil edgewise gave a higher germination than when flat. He mentioned the great difficulty experienced in raising many Cypripediums and the failure of imported seed. Referring to temperature conditions he cited Nemesia as germinating better at low temperatures despite its origin, and in regard to age and maturity preferred two-year-old leek seed and stated that old seed of stocks gave a higher proportion of doubles. He concluded by recounting the interesting story of the re-introduction of *Lathyrus magellanicus* by seed.



NELUMBIUM FROM THE SLOANE COLLECTION. Placed in water, after removal of seed-coat, at 5 p.m. on May 12, 1942. Temp. 32° C. At 2 p.m. on May 13, ½in. long. Kept at room temperature afterwards and photographed on May 17, at 10 a.m.

Mr. G. W. Robinson remarked upon the slow germination of Hellebore seed often after 3–4 years from date of sowing, and commented on the Primulas, some of which proved troublesome. High temperatures in bush fires, well known to cause germination in Acacia spp., were observed in South America by him to cause *Sisyrinchium striatum* to germinate readily. Seed some eighty years old of Cytisus, Melilotus and other species had been successfully germinated.

Dr. J. Ramsbottom exhibited seedlings of *Albizzia Julibrissin* and Nelumbium. The seeds of the Albizzia were collected during Sir George Staunton's mission to China in 1793 and then stored in the Department of Botany at the British Museum. Following the fire in the Department at South Kensington due to an air raid in September 1940, the seeds became damp and when they were examined in November, were found to have germinated. Three of the seedlings were planted, and grown on at Chelsea Physic Garden ; only one, however, survived the air attacks of May 1941. The main interest is that the seeds germinated 'spontaneously' after their 147 years storage.

Three Nelumbium seedlings were shown. Two of these were grown from fruits ('seeds') found in the prehistoric peat bed in the Pulantien Basin, South Manchuria: they are "probably at least three or four hundred years old". The seeds were presented to the Museum by Prof. I. Ohga in 1926; at that time in his experiments they showed a very high percentage of germination. The seeds, after the removal of their seed coats, germinated in water at 32° C., one after twenty-one hours, the other by the following morning. The third seedling was grown from a 'seed' taken from a receptacle in the Sloane collections. Robert Brown during 1843–1855 succeeded in obtaining twelve seedlings from fourteen of these seeds. As they were then not less than 150 years old this has stood as the record for longevity of seeds of known origin: Ohga tried twelve seeds in 1926 but none germinated though one seed, on being opened, showed green cotyledons. Only one seed was tried and within twenty-one hours it produced an outgrowth half an inch in length which had increased to more than an inch before the end of the second day. The Sloane Catalogue cannot be consulted conveniently at present so no exact data are available, but eighty-seven years have elapsed since the last of Robert Brown's classical experiments. The most surprising fact about the germination is the immediate rapid and rampant growth after a dormancy of centuries.

Mr. C. P. Raffill dealt with difficulties experienced in seed importation, stating that only 10 per cent of the seed importations into Kew gave satisfactory germination. He had experienced the greatest difficulty with seeds from Malaya, South America, East Australia, and East and West Africa and Ceylon. Magnolia seed from China and the Himalayan region failed when imported dry, but when kept moist by moss some germination was obtained. The seed of Michelia and related plants proved short-lived. Many plants from New Zealand (including Araliaceæ) produced seed which apparently died on drying; seed of Nothofagus also was imported successfully in damp storage but unsuccessfully when dried. Reference was made to the small degree of success obtained with the seeds of many tropical fruits.

In a brief reply Dr. M. A. H. Tincker referred to the availability of rapid means of transport by air and of modern methods of temperature control which should be tested for seed importation.

ELECTRICITY OF CLOUD AND RAIN

By DR. J. ALAN CHALMERS
University of Durham

IN his recent presidential address to the Royal Meteorological Society, under the above title, Sir George Simpson[1] has given a full account of experimental results on the processes giving rise to electrical charges on raindrops and in clouds. Due largely to work in which Sir George has himself taken a big part, a fairly clear picture is now available of the electrical structure of a thunder-cloud, showing a positive charge above and a negative charge below, with a localized concentration of positive charge at a still lower level. There must be two processes of separation of charge: an upper one, in a region where the temperature is below freezing-point, and where the separation has been ascribed by Simpson and Scrase[2] to a process of friction between ice-particles, giving a negative charge to the larger particles and a positive charge to the air; and a lower one, where the precipitation is entirely in liquid form, and where the separation of charge is ascribed to the breaking of drops, giving positive drops and a negative charge to the air.

But, as Sir George Simpson points out, the electrical phenomena associated with continuous rain, such as that preceding a warm front, are by no means so clearly understood. Although the meteorological conditions are probably less complex than in a thunder-cloud, the electrical manifestations are much less intense; and technique, such as that of the altielectrograph, which is available for the investigation of thunder-clouds, is not sufficiently sensitive for the purpose of investigating clouds of the nimbo-stratus type responsible for continuous rain.

The investigation of electrical phenomena due to continuous rain clouds has been mainly confined to the measurement of the charges on the rain and of the vertical potential gradient at the earth's surface. It has been generally found that the charge on the rain is predominantly positive, while the potential gradient is usually negative; the correlation between the two has been established in the case of long-continued gentle rain, in a record analysed by Chalmers and Little[3] and in records mentioned by Simpson[1].

The problem of the electricity in continuous rain and the clouds responsible for it amounts to the discussion of the production of positively charged rain and a negative potential gradient. The negative potential gradient must be due to a negative charge situated in the base of the cloud or below it.

Electrical Processes at Work

The fundamental problem in regard to the electricity of continuous rain is one which can be stated in a number of different forms, now seen to be equivalent. In its simplest form it is as set out by Simpson[1], namely, the question as to how the rain gets its positive charge. There are two known processes by which water drops could obtain a positive charge under conditions of the kind under discussion: there is the process of the breaking of drops put forward by Simpson[4], which is recognized as responsible for the positive charge in the base of the thunder-cloud; and there is the 'influence' process suggested by Wilson[5] and verified in laboratory experiments by Gott[6].

The breaking-drop process leaves a negative charge in the air, and this will give rise to the negative potential gradient directly. On the other hand, if the influence process gives a positive charge to the drops, there must first be a negative potential gradient below the cloud, due to a negative charge in the base of the cloud. If, within the cloud, there is the same process of ice-friction which operates in the thunder-cloud, this will give the requisite negative potential gradient.

The two processes which could give rise to the charges on raindrops are sharply distinguished in regard to the origin of the charges in the cloud and the consequent negative potential gradient. The breaking-drop process will, in itself, give rise to a negative charge in the cloud, and there will be no need for any positive charge to be assumed in the cloud. On the other hand, the influence process requires a 'bipolar' cloud, with negative charge below.

In the breaking-drop theory, the primary result of the process is the positive rain, the negative potential gradient being a consequence of this; whereas in the other process, the first effect must be the production of a bipolar cloud, with negative potential gradient beneath, the positive rain arising from this by the influence process.

It is, of course, possible that both processes occur in the same cloud, as is the case in a thunder-cloud; then the negative charge in the base of the cloud may be partly due to the charge in the air from the breaking of drops and partly due to the process which gives a bipolar cloud.

Vertical Electrical Currents

The problem can be regarded in a different way if we make use of the important fact that conditions within and near a cloud giving continuous rain are quite steady; therefore whatever electrical processes may occur will probably not give rise to any marked changes in the distribution of electricity and give no added accumulations of charge. Thus we have the general principle that, for any one cloud, the total vertical electric current density must be nearly the same at all levels and so the same above, within or below the cloud; if we can determine the current density at any one level we know, approximately, its value at other levels. In particular, if by any argument we can determine the sign of the current density at any one level we know the sign at other levels. The vertical electric current is composed of the current carried by the rain, the conduction current and any convection current due to space charges carried up by vertical air currents.

Currents above the Cloud. It is perhaps simplest to discuss the vertical electric current density above the cloud, where the only current must be a conduction current between the ionosphere and the top of the cloud. If the cloud is bipolar, the potential of the top of the cloud may be higher than that of the ionosphere and hence there will be a negative current downwards. On the other hand, if the cloud is negative, the downward conduction current above the cloud will be positive. It is to be expected that the ions comprising the conduction current will originate in the ionosphere rather than in the cloud, and therefore the results of Wigand[7], who used a balloon to make measurements of conductivity above a stratiform cloud, are important. Wigand found the conductivity to be mainly due to negative ions, which is in agreement with the idea of a bipolar cloud, rather than a negative cloud.

Current within the Cloud. It can be seen that the same results occur if we consider the processes of separation within the cloud. In the formation and maintenance of a bipolar cloud, the process of separation gives a negative current downwards, as also occurs above the cloud; while in the breaking-drop process there is a positive current downwards. In the case where both processes occur in the same cloud, the upper process may produce charged drops which fall to the level where the lower process occurs, but there can be little effect of the lower process at the higher level, so that the resultant vertical electric current will be negative downwards.

Current below the Cloud. Below the cloud the vertical electric current consists mainly of the rain current carrying positive charge downwards and the conduction current carrying positive charge upwards. The sign of the resultant current therefore depends on the relative magnitudes of these two currents. Whereas the rain current can easily be measured, the conduction current is largely due to point-discharge, and though this can be measured for a single point, it can only be converted into a current density by assuming the separation of points equivalent to the one used; this has been discussed by Chalmers and Little[3] and by Chalmers[8]. If there is a bipolar cloud, the conduction current must be greater than the rain current, to give a resultant negative current downwards, while if there is a negative cloud the rain current is the greater.

Wigand's balloon measurements of conductivity below the cloud show a predominance of positive conductivity, as would be expected from the positive ions produced by point discharge.

Results for Snow

Since the breaking-drop process, and probably also Wilson's influence process, are effective for water in the liquid state only and not in the solid state, we should expect the results for snow to differ from those for rain. Simpson[1] has pointed out that the potential gradients during snowfall show no significant difference from those during rainfall; this indicates that the process responsible for the potential gradient does not depend on the presence of liquid water, and so cannot be the breaking-drop process, but must, presumably, be a process within the cloud below the freezing-point, for example, the ice-friction process. There seems a general consensus of experimental evidence that continuously falling snow carries a negative charge, and this is what we should expect if there is a bipolar cloud and no influence process by which the negative charge on particles from its base is lost and positive acquired. The results for snow are in agreement with the idea of a bipolar cloud, giving rise to a negative potential gradient, which, when there are raindrops, makes these positive by Wilson's influence process.

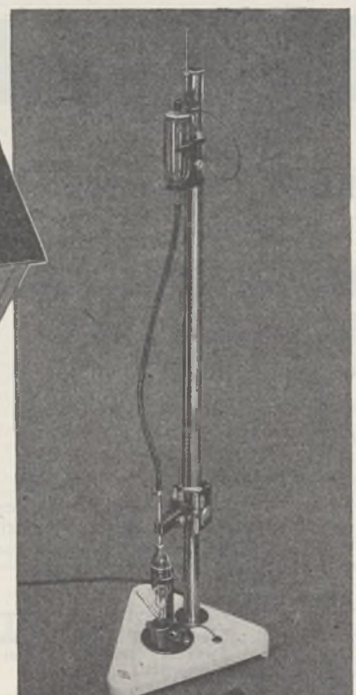
Eiffel Tower Observations

Chauveau[9] has given an account of observations undertaken at the Eiffel Tower which are of importance in connexion with the present discussion. Chauveau found that, frequently during continuous rain, the potential gradient at the top of the Eiffel Tower remains positive, though less than its fine-weather value, while that at the foot of the Tower is negative. As can be seen by drawing lines of force, the only interpretation of this, as the Tower is a conductor, is that the atmosphere between the levels of the top and foot of the Tower carries a negative charge. Since this would quickly be dissipated by conduction currents, there must be some process at work which provides a negative charge at this level but leaves no positive charge within the atmosphere; the breaking-drop process operating near the earth's surface would account for these results very simply, giving also the positive charge found on the rain.

It seems difficult to reconcile these results with those for snow, since in the absence of the breaking-drop process we should expect matters to be the same at the foot of the Tower as at the top, that is, with a reduced positive potential gradient rather than a negative. It is also difficult to reconcile these results with the predominantly positive conductivity below clouds found by Wigand.

Conclusion

Apart from the Eiffel Tower observations, the general trend of the results for continuous rain suggest that there is a process of separation of charge within



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the cloud, such as the ice-friction process, giving a negative potential gradient, and the raindrops falling in this potential gradient acquire a positive charge as described in Wilson's theory. Calculations showing the orders of magnitude of the currents and potential gradients have been given by Chalmers and Little[3]. In order to give an account also of the Eiffel Tower observations, we might add the breaking-drop process occurring near the earth's surface, but difficulties and anomalies remain, and it may be that conditions near the Eiffel Tower are peculiar.

A great deal remains to be done to confirm or disprove the ideas described above; among investigations that would be profitable may be suggested the measurement of rain currents and potential gradients under conditions similar to those of the Eiffel Tower, the measurement of rain currents and point-discharge currents using as discharger one of the trees of a plantation of similar trees, the measurement of potential gradients at various heights with a more sensitive alti-electrograph, and the repetition of Wigand's measurements when rain currents and potential gradients are simultaneously measured.

[1] Simpson, Sir G. C., *Quart. J. Roy. Met. Soc.*, January, 1942.
[2] Simpson, Sir G. C., and Scrase, F. J., *Proc. Roy. Soc.*, A, **161**, 309 (1939).
[3] Chalmers, J. A., and Little, E. W. R., *Terr. Mag.*, **45**, 451 (1940).
[4] Simpson, G. C., *Phil. Trans.*, **209**, 379 (1909).
[5] Wilson, C. T. R., *J. Frank. Inst.*, **208**, 1 (1929).
[6] Gott, J. P., *Proc. Roy. Soc.*, A, **142**, 242 (1933); **151**, 665 (1935).
[7] Wigand, A., *Ann. Phys.*, **66**, 81 (1921).
[8] Chalmers, J. A., *Phil. Mag.* (7), **31**, 363 (1941).
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OBITUARIES

Prof. B. Malinowski

ANTHROPOLOGY has suffered a great loss by the death of Prof. Bronislaw Kasper Malinowski at Yale on May 16. Holding an international reputation in his field, he was a scientific worker with a subtle and constructive theoretical mind, a teacher who was stimulating to the highest degree, and a man of striking and in many ways most attractive personality.

Born on April 7, 1884, in Poland, Malinowski was first educated at the King Jan Sobieski Public School and later at the University of Cracow, where he graduated Ph.D. *summa cum laude* in 1908. Intending to do research work in physical science, he was prevented by the ill-health which interfered with his work all his life, and later turned to the social sciences, which he studied for a while at Leipzig under Karl Bücher. In 1910 he came to England, and as a student of the late C. G. Seligman began that long association with the London School of Economics and with British anthropology which proved so fruitful for the science he adopted.

At the London School of Economics he became a lecturer in 1913, but went with the Robert Mond Anthropological Expedition to New Guinea in 1914, and carried out field-work there, with intervals in Australia, until 1919. Returning to Europe in 1920, he again took up a post at the London School of Economics in 1921, and remained a member of the staff until his death, being appointed to the newly created chair of anthropology in the University of London in 1927. His links with the United States of America, however, had been many since his first visit there in 1926 at the invitation of the Laura Spelman Rockefeller Memorial. In 1936 the degree of Honorary D.Sc. was conferred upon him by Harvard University, and in 1939 while on leave in America he participated in the teaching at the Department of Anthropology at Yale University, where he became Bernice P. Bishop visiting professor for 1941–42.

As a writer and teacher Malinowski had a profound influence on the development of anthropological thought and research, not only in Great Britain but also abroad. He was not a systematist, and had little interest in the minutiæ of comparative investigation; he attacked, often wittily and sometimes violently, work of historical reconstruction on one hand and of pure technological analysis on the other. But to social anthropology, which he regarded simply as a branch of sociology, he contributed extensively both in methods of research and in fundamental generalizations. His name will always be associated with the "Functional Method", which however much it owed to Durkheim and the school of *L'Année Sociologique*, was by Malinowski re-formulated, developed, christened (complete with capitals) and forged into a powerful instrument for the analysis of cultural relationships and as a basis for a technique of field research. In its broadest sense indeed, under Malinowski's skilful handling, it became not merely a method of studying social phenomena but also an integrative set of generalizations about them and their inter-relations, based upon assumptions about the fundamental drives to human behaviour—in short, it was almost a philosophy of human culture. As such, it invited criticism while it spurred to further investigations. It also awoke interest in circles far beyond those of anthropology alone, bringing into touch studies of social institutions, of political organization, of religion, of technology, and of language.

The stimulus of Malinowski's writings and teaching was manifold. Not since Sir James Frazer has any other anthropologist in Great Britain so struck the imagination of a wide range of readers both here and abroad, by the combination of a vivid rich style, a breadth of treatment and a dramatic subject-matter. His first considerable work, "Argonauts of the Western Pacific", treating of the elaborate ceremonial exchange system of the Trobriand Islanders, and their magic rites, appeared in 1922. This was followed by "Crime and Custom in Savage Society", and "Myth in Primitive Society", in 1926; and "The Father in Primitive Psychology", and "Sex and Repression in Savage Society", in 1927, all based on his long period of intensive research in the same area. In 1929 appeared his best-known work, "The Sexual Life of Savages in North-western Melanesia". His last major publication, "Coral Gardens and Their Magic", appeared in two volumes in 1935. This, less widely read than the other books, is unexampled in its detailed analysis of a primitive agricultural system and its associated ritual; moreover, it contains an elaborate exposition of his theory of meaning in language, especially in magical language, a subject in which he had always a keen interest and to which he made a notable contribution.

As a teacher Malinowski was brilliant, giving of himself unsparingly, and treating his class not as pupils but as co-workers. More and more in later years he tended to abandon the formal lecture for a free discussion in the Socratic style, enlivening it by his flashing wit, and driving home a point in any one of half a dozen European languages to suit the members of the cosmopolitan group usually assembled around him.

But Malinowski's interests were not purely academic. He firmly believed that the test of a science in the last resort is its applicability to practical affairs. He tackled the problem in a systematic way, and in his training of government officials and missionaries and in his work for the International Institute of African Languages and Cultures, and the British Social Hygiene Council, he was one of the first to demonstrate the value of applied anthropology for Colonial affairs.

In all this, his gifts as a scientific worker and a teacher were closely bound up with his personality. To his powerful intellect were allied a great breadth of culture and charm of manner. His emotional hypersensitivity sometimes led him to harsh judgments of men and their motives, but his acute sense of values, his fundamental lack of affectation and his real humanity made his friendship a privilege and gave a richness to all his personal contacts.

RAYMOND FIRTH.

Prof. H. L. Bowman

DR. HERBERT LISTER BOWMAN, who retired from the chair of mineralogy at Oxford in July 1941, died unexpectedly in a nursing home at Oxford on April 22 at the age of sixty-eight.

Born on March 15, 1874, Bowman was educated at Eton College and New College, Oxford, where he took the Final Honour Schools of Natural Science in chemistry in 1895 and in physics in 1896, and proceeded to his M.A. in 1895 and to the D.Sc. degree in 1908. He became attracted to the study of minerals through the teaching of Prof. (now Sir) Henry A. Miers, who had been appointed professor of mineralogy in 1895 in succession to M. H. N. Storey Maskelyne, who had occupied the chair for thirty-nine years.

During the latter part of 1896 and in 1897 Bowman was engaged in research work and also devoted much time to helping in the rearrangement and registration of the mineral collection and in the development of several special exhibits in the Oxford Museum. In 1898 he went to Munich to study under Prof. Groth, and after spending eight months there and in visiting famous mineral collections in Germany and Austria, he returned to Oxford and was appointed demonstrator in mineralogy. During these years he also gave much help in the development and equipment of the Mineral Department at Oxford, which had no laboratory accommodation previous to 1895, and throughout his life he devoted much thought and time in this direction. Bowman was appointed Waynflete professor of mineralogy early in 1909 in succession to Prof. Miers, the appointment carrying with it a fellowship at Magdalen College. The title was altered in 1927 to include crystallography in recognition of the importance of that subject.

Bowman was a very painstaking and accurate research worker and teacher, and those who studied under him will remember his kindness and his patience and the help and advice which he always gave so readily. Most of his published researches deal with the chemical and physical properties of minerals and their modes of occurrence and were published in the *Mineralogical Magazine*, and his keen interest in meteorites is shown in the detailed examination of the Chandakapur and Dokâchi stones which he carried out in collaboration with H. E. Clarke and the results of which are contained in two papers also published in the *Mineralogical Magazine*. He also undertook the revision for the second edition of the standard text-book Miers' "Mineralogy" which was published in 1929.

An ardent collector of minerals, Bowman took part in Oxford expeditions to many English mineral localities, went with the British Association to South Africa and the International Geological Congress to Canada and Sweden. He also visited Switzerland annually for many years, and the Oxford collection is the richer by many specimens collected and presented by him. He inherited a keen interest in music and botany from his father, Mr. J. H. Bowman of Greenham Common, Newbury, and Dr. and Mrs. Bowman had been enthusiastic members of the Oxford Orchestral Society for many years. He also had great mechanical ability, and during the War of 1914–18 he did munition work in Birmingham. He devoted much time and thought to the designing and improvement of apparatus used in his department and introduced many novel experiments into his lectures.

To those who did not know him well, Bowman may have seemed reserved and shy, but he was an extremely kind and unselfish man, always ready to discuss problems and difficulties, and those who knew him intimately will remember him with great affection. He undertook many administrative duties at different times; thus he had served as Recorder of the Geological Section of the British Association, secretary to the Delegates of the University Museum, Oxford, vice-president of Magdalen College and of the Mineralogical Society. This left him little time for research work, but it was his intention, following his retirement, to take up active research again in his old department; his untimely death is a sad blow to his many friends.

In 1921 he married Pleasance Edith, daughter of Mr. James Walker of Kempsey, Worcester (under whom he studied physics in the Clarendon Laboratory at Oxford), and their married life was one of ideal companionship and perfect happiness.

R. C. SPILLER.

IT has been announced that among the Czechoslovak patriots recently executed by the Germans are a university dean and two professors, several secondary schoolmasters and a number of young men described as university students, although the universities have been closed for nearly two years. One of the professors was Prof. Jaromir Šamal, formerly professor of entomology in the Prague College of Agriculture, whose work had considerable local importance through his books in Czech on the anatomy and life-history of insects, on their ecology and their economic importance; Dr. Šamal was forty-one years of age.

WE regret to announce the following deaths:

Captain J. D. S. Pendlebury, formerly curator of Knossos and author of works on the archæology of Crete and Egypt, during the invasion of Crete in 1941, aged thirty-six.

Dr. George A. Reisner, professor of Egyptology at Harvard and curator of the Egyptian Department of the Boston Museum of Fine Arts, on June 6, aged seventy-four.

Prof. James Joseph Walsh, professor of physiological psychology at Cathedral College, New York, and medical director of the School of Sociology at Fordham University, aged seventy-seven.

NEWS and VIEWS

The U.S.S.R. Academy of Sciences and the Royal Society

IN response to a message from the Academy of Sciences of the U.S.S.R., Sir Henry Dale has sent the following reply on behalf of the Royal Society: "The Royal Society of London welcomes the inspiring appeal to the scientists of Britain, made by the members of the Soviet Academy of Sciences at their May conference. We appreciate the great honour bestowed on our President, Sir Henry Dale, and Prof. J. B. S. Haldane, by their election as honorary members of your Academy. The holding of the conference of your Academy at Sverdlovsk is symbolic of the scientific and technical progress made in the newly developed regions of the Soviet Union. We congratulate you on this mobilization of your prodigious resources, which encourages your friends and bodes ill for our enemies. The achievements of your scientists in all fields of research are followed by us with the liveliest admiration. The superb efforts of your countrymen in their resistance to the aggressor would have been impossible, if your technical resources had not been based on a great development of abstract science.

"British scientists likewise have made contribution to the common cause. There has been a growing application of scientific principles to our war effort, and, indeed, to all aspects of our national life. One result of this is to be seen in the remarkably high standard of the health of our people, in spite of ruthless air attacks upon our citizens, and other conditions which might have brought disease. Research has enabled the engineering industry of Britain to make immense advances since the War began. Agricultural research has played its part in reducing the shipping required for the transport of food, and thus releasing more to carry arms and munitions to the Soviet Union. Many inventions made by British scientists have been of decisive importance for the War, such as radio-location, and the device which rendered harmless the magnetic mine. We agree profoundly with you, in the belief that all our technical and scientific resources should be used to the utmost in this War to preserve liberty and democracy. Only thus, as you say, can science itself be saved, and resume its beneficent tasks on behalf of all mankind. Our most earnest and heartfelt hopes are with you in the present and the coming battles, upon the outcome of which the course of history for our countries and for the whole world depends."

Exchange of Scientific Information with the U.S.S.R.

MEN of science in Great Britain now have the opportunity of exchanging scientific communications and inquiries with the U.S.S.R. through official channels. A Conference was recently called at the Royal Society's rooms to discuss the development of contacts between British and Russian scientific workers. A Committee was appointed to examine the possibilities, and its work has been greatly facilitated by the sympathetic attitude of the Embassy of the U.S.S.R. The following procedure has been approved by the bodies concerned. Letters addressed by individual British men of science to individual Russian men of science, or communications from British scientific and technical societies to the corresponding Russian societies, can be forwarded either to: Sir John Russell, F.R.S., Ministry of Information, Malet Street, London, W.C.1, or Mr. J. G. Crowther, The British Council, 3, Hanover Street, London, W.C.1. They will take the necessary steps to forward the communications to the U.S.S.R.

Control of Cattle Diseases

A SCHEME for the control of certain diseases of cattle—mastitis, contagious abortion, sterility and Johne's disease—has been under the consideration of the Ministry of Agriculture for some time. It has the active support of the National Veterinary Medical Association of Great Britain and Ireland and of the National Farmers' Union, and it was brought into operation on June 1. The scheme is voluntary. Farmers wishing to participate are required to enter into an agreement. The Ministry of Agriculture provides free laboratory services for the diagnostic work, free vaccines for bovine brucellosis, and sulphanilamide at a reduced charge. The practising veterinary surgeon undertakes the work on the farm at fees that have been agreed upon. The National Veterinary Association has been pressing for action for some time and has prepared a report detailing the importance of these diseases and showing the extent of the losses they inflict upon the livestock industry in Great Britain. In terms of money, the losses from the first three of the diseases referred to above are estimated to amount to more than £17,000,000 a year. The annual loss of milk due to these three diseases alone (such a serious item in war-time) is estimated to be 198,000,000 gallons.

The position regarding bovine contagious abortion is discussed by F. Francis in the *Veterinary Record* of May 2 (p. 95). He describes the stages in which the essential knowledge of the bovine brucellosis problem has been built up. Much work has been done on the subject in many countries. In suitable circumstances the disease can be controlled by means of a serological test for evidence of infection and the adoption of measures to remove infected animals from the herds. The agglutination test is the most suitable one for this purpose, and it has been used on a large scale throughout the world. Small-scale attempts to control the disease in cattle have been made for more than thirty years and large numbers of herds have been cleared of infection. For this disease, however, the elimination of infection from individual herds is not sufficient; such herds are almost always surrounded by herds in which the organism is present, and they are in great danger of re-acquiring infection. The ideal would be to eradicate the disease on an 'area' basis until ultimately the whole country is cleared. A vast campaign to control bovine brucellosis on these lines has been in operation for some years in the United States and impressive results have been achieved, but it has been found to be costly.

Workers in the United States have developed a vaccine with 'strain 19' of *Br. abortus* which is of reduced virulence, but capable of conferring useful immunity. When young calves contract infection with *Br. abortus* after birth, they usually overcome it completely by the time they reach sexual maturity, and advantage has been taken of this phenomenon. 'Strain 19' has been used in the United States during the last few years for the vaccination of calves, and the reports show good results. McEwen in Great Britain has also developed and tested a strain of low virulence, 'strain 45 (20)'. In laboratory and field experiments he has found that vaccinated cattle acquire a serviceable immunity. The policy now adopted by the Ministry of Agriculture is to use these two vaccines in infected herds in an attempt to reduce the immediate losses. From June 1 no animal in a *TT* (tuberculin tested) herd shall be vaccinated with live *Br. abortus* except with the approval of the Ministry of Agriculture, and only with an approved vaccine. Two approved vaccines are issued by the Ministry of Agriculture, No. 1 (standard) vaccine, which is prepared from the American, 'strain 19', and No. 2 vaccine, which is prepared from 'strain 45 (20)'.

Health Contrasts in the United States

An article in the March issue of the *Statistical Bulletin*, the organ of the Metropolitan Life Insurance Company of New York, discusses the difference in health in the United States during the War of 1914–18 compared with that in the present struggle, and comes to the conclusion that America is better prepared now for the hardships of modern warfare than twenty-five years ago. This is shown by the mortality among the industry policy holders of the Company, whose death-rate in the group 1–74 has been reduced slightly more than 50 per cent during the last quarter of a century. The diseases of childhood and infancy such as measles, whooping cough, scarlet fever, diphtheria, diarrhœa and enteritis have been virtually eliminated as causes of death during this period. There has been a considerable saving of life at this early age, and many young persons living to-day have been spared the disabling sequels of these diseases, so that thousands are now available for war service who would otherwise have been rejected. The death-rate from tuberculosis among the policy holders has been reduced by about one fifth. This is of great importance in connexion with the war effort, as many of the sufferers from tuberculosis are between the ages of twenty and fifty to which the great majority of the Fighting Forces belong. The mortality from syphilis, which occurs principally in youth and middle age and tends to increase in war-time, is less than half what it was in 1917. As regards influenza and pneumonia, which caused such heavy losses during 1914–18, the recent researches into the causal agent of the former are encouraging, while the latter, thanks to chemotherapy, has lost much of its terrors.

The increasing industrialization in the United States suggests that there may be an increase in fatal accidents in the near future, but the advance in industrial hygiene and prevention of accidents make it more likely that many lives and working days will be saved which under former conditions would have been lost. Improvement in pre-natal care, obstetric and hospital facilities is shown by the fact that whereas twenty-five years ago more than 17 out of every 100,000 policy holders died in childbirth, to-day this rate is reduced to 5. The great increase in motor accidents since 1917, due to the great increase in number of motor-vehicles, may possibly be mitigated by the curtailment of the supply of rubber and petrol.

Health of the United States Army

According to the annual report of the Surgeon-General of the U.S. Army, summarized in the *Journal of the American Medical Association* of April 18, 257,136 men were reported sick from all causes in 1940, giving an annual rate per thousand of 763·3, an increase of 44 per cent over that of 1939, which was the lowest on record. The largest number of admissions was due to respiratory diseases. Then came infectious diseases and diseases of the digestive system. There were 267 admissions with 108 deaths due to aircraft accidents in 1940, and 32 deaths from accidental drowning. The admission for venereal diseases was 42·5 per thousand, and the number of days lost due to this cause 456,148. The average number of men absent from duty each day for venereal disease was 1,246 and the average length of treatment was 52 days. The average number of days lost for syphilis was 28, for gonorrhœa 35 and for other venereal diseases 20. During the year, 1·39 per cent of the strength of the army was lost by discharge or retirement for physical disability. Dementia præcox was the chief cause for discharge. Tuberculosis reached a new low level. There were 229 deaths attributed to motor accidents.

Electrically Driven Excavators

In a paper given before the Institution of Electrical Engineers on May 14, P. H. R. Durand points out that the electrically equipped single-bucket excavator is employed extensively in the quarrying of rocks such as limestone and chalk for cement manufacture, ironstone and other minerals and also for excavating granite, sand and gravel, clays and shales. Large installations are used in the open-cast mining of coal. These machines are also used sometimes around industrial works for handling materials such as blast-furnace slag. In some quarries the excavator provides raw material which is processed in an adjoining factory and for which there may be limited accommodation prior to processing. The excavator is here the starting-point of a mass-production unit, its rate of output being measured by the hour instead of by the week or month, and in applications of this type it must be regarded as an automatic machine. The author describes the sphere of application of the excavators and, in commenting on the increasing importance of electric drive, gives an explanation of the fundamental motions and structural limitations of the machines.

A summary of the special service conditions precedes a discussion on electric drive methods for the two main groups of excavators, the 'friction' type and the individual-drive machine, where the application of the modern Ward-Leonard system with 3-coil dynamo and separately excited motor is referred to in some detail. Main and auxiliary equipment is described from the electrical and mechanical aspects, and installation and wiring details are supplemented by illustrations of typical equipment layouts and wiring diagrams. Attention is directed to certain special aspects of power supply and distribution to excavating projects, representative power consumptions being given. The scope of the paper is limited by present circumstances, no reference being made to Continental or overseas practice, or to the dipper dredge, which, possessing an operating cycle similar to that of shovel excavators, is equipped with motors and control of equivalent characteristics. Illustrations are confined to the smaller machines, since up to the present time the scope of excavating operations in Great Britain has not stimulated any demand for the larger machines except for stripping shovels to remove deep over-burden in the ironstone mines.

Prevention of Blindness

The March issue of the *Boletin de la Oficina Sanitaria Panamericana* gives the following list of international societies for the prevention of blindness: The International Society for the Prophylaxis of Blindness was organized in 1929 under the presidency of the late Dr. Félix de Lapersonne, professor of ophthalmology in the Paris Medical Faculty, and held several meetings in various European capitals, the last being in Cairo in December 1937 in conjunction with the Fifteenth International Congress of Ophthalmology. Its office is at 66 Boulevard St Michel, Paris 6e. In 1930 it became united with the International Organization for the Campaign against Trachoma, the organ of which is the *Revue internationale de Trachome*. Other international societies of the kind are the International Association for Blind Students, 1 Rue Etienne Dumont, Geneva, and the Spanish-American Association for the Blind, 1545 Madison Avenue, New York. Reference may also be made to the International Council of Ophthalmology, Rotterdam, and the International Federation of Ophthalmologic Societies.

Bibliography of Seismology

The *Bibliography of Seismology* for the period July–December 1941, prepared at the Dominion Observatory, Ottawa, by Mr. Ernest A. Hodgson (now president of the Seismological Society of America), has just been received. It covers 145 items, ranging through pure and applied seismology, building construction, cosmogony, engineering, instruments, insurance, oceanography and time-keeping. About forty-five items deal with seismic prospecting and patents associated with it, and forty-two items deal with instruments, chiefly for the detection of various types of natural and artificial seismic waves. Items in Nature are listed. Several items deal with seismic surveying in the U.S.S.R. (for example, "Prospects of Seismic Survey by the Method of Refracted Waves in the Region of Ust-Eniseisk Port" by R. M. Demenitskaia, Problemi Arktiki, No. 5, 81–92, Leningrad, 1939), and it is not known whether or not the War has interfered with many of these projects. From time to time luminous phenomena have been reported as accompanying seismic phenomena, and one such is listed: "Sur les phénomènes lumineux qui ont accompagné le tremblement de terre de Roumanie du 10 novembre 1940", G. Demetrescu and G. Petrescu, Académie Roumaine, Bulletin de la Section Scientifique, Tome 23, No. 6, pp. 5, 1 chart, Jan., 1941."

"Thorpe's Dictionary of Applied Chemistry"

Five volumes of the current edition of "Thorpe's Dictionary of Applied Chemistry" were published under the editorship of Sir Jocelyn Thorpe and Dr. Martha A. Whiteley. With the death of Sir Jocelyn Thorpe new editorial arrangements have been necessary, and in order to maintain a balance between the various branches of chemical science, an editorial board has been formed, comprising Prof. I. M. Heilbron (professor of organic chemistry and director of the Laboratories for Organic Chemistry at the Imperial College) (chairman), Prof. H. J. Emeleus (assistant professor and reader in inorganic chemistry at the Imperial College), Prof. H. W. Melville (professor of chemistry in the University of Aberdeen), and Prof. A. R. Todd (Sir Samuel Hall professor of chemistry and director of the Chemical Laboratories in the University of Manchester). This Board will determine the general editorial policy in conjunction with the publishers. Dr. Whiteley continues as editor, and Dr. A. J. E. Welch (assistant lecturer in inorganic chemistry at the Imperial College) becomes assistant editor; thus the association with the Imperial College is being maintained. Vol. 6 of the current edition is in the press, and it is proposed to complete the edition with eight further volumes, published at yearly intervals. Although the Board does not consider that any major modification of the general character of the work is required, certain changes in the scope of the articles, particularly with regard to physical chemistry topics, are to be made.

Announcements

The University of Marburg, with the support of the Behring Works, has founded an Emil von Behring prize consisting of a medal and a sum of five thousand gold marks. It will be awarded every two years for scientific work in medicine, veterinary medicine or natural science, with special reference to immunity and control of epidemics.

Under the title "Why I am a Rationalist: Books which have Influenced Me", Messrs. C. A. Watts and Co., Ltd., have published for the Rationalist Press Association, Ltd., a series of autobiographical essays which originally appeared in the "Literary Guide". The contributors include the Right Hon. Lord Snell, Prof. J. B. S. Haldane, Marjorie Bowen, Prof. H. Levy, Ivor Brown, W. B. Curry, and others. The contributions are of varied merit but form a useful, if scarcely critical, guide to a wider range of literature than can fairly be claimed by rationalism as its own. The book may well direct readers to books which to-day do not receive the attention they deserve.

The tenth annual Summer Conference on Spectroscopy and Its Applications, arranged jointly by the Optical Society of America and the Massachusetts Institute of Technology, will be held at the latter during July 20–22. A symposium on fluorescence and phosphorescence is planned in connexion with the Conference. Admittance to the Conference will be by reservation as usual. Further information and tickets can be obtained from Prof. George R. Harrison, Massachusetts Institute of Technology, Cambridge, Massachusetts. The usual courses in spectroscopy will not be given at the Massachusetts Institute of Technology this summer.

Prof. M. Polanyi and Mr. A. G. Evans write: We wish to supplement our letter entitled "Calculation of Steric Hindrance" (Nature, May 30, p. 608) by the following footnote which was attached to the letter in proof, but was not received in time to be printed: The presence of steric hindrance in the case of neopentyl has been briefly pointed out by Hughes (*Trans. Far. Soc.*, 623; 1941) on what seem to be similar lines. He, however, interprets the slowness of reactions of the type (1) for *t*-butyl halides on a different basis. See also a recent paper by Bartlett and Rosen (*J. Amer. Chem. Soc.*, 64, 543; 1942) on steric hindrance in neopentyl halides.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Nutrition and the War

I WOULD like to thank Dr. Kon for his kind remarks about my book[1] in his review in NATURE[2], and for his critical comments, which, coming from a person of his standing in the nutritional world, are of considerable value to me. I would like, however, to comment on some of the statements which he has made.

On p. 82 of my book, immediately preceding the food tables, I state, "It will probably be noticed that peas, beans and lentils are good in almost every constituent, but it should be remembered that we eat relatively small quantities of them at a time so that in their case the appraisement may be a little misleading. In the case of potatoes, which are listed as poor in calories, they may constitute a significant proportion of one's calorific intake if enough of them is eaten." In view of this statement, I feel that Dr. Kon is unjust in his comment that there is "a lack of appreciation that it is not so much the richness of a product in any given food factor as the amount consumed that matters in the end".

Dr. Kon points out that this lack of appreciation has led to the "strange selection of curry powder as the best source of iron". McCance and Widdowson[3], to whom incidentally Dr. Kon refers me, state on p. 9 of their report, "Curry powder contained more than three times as much iron as any other food (75 mgm. per 100 gm.)". That curry powder is so rich in iron that the amount used in making a meat curry is sufficient to secure an important increase in the amount of iron eaten can be seen from the figures given below (McCance and Widdowson[3], p. 103).

Beef stew	..	2·49 mgm. of Fe per 100 gm.
Curried meat	..	4·70 ,, ,, ,, ,, ,, ,,

In the circumstances I do not agree with Dr. Kon that my selection of curry powder as the best source of iron is a strange one.

In mentioning my reference to the food value of ethyl alcohol, Dr. Kon refers to this "misinterpretation of Mitchell's work". I purposely made no attempt to interpret Mitchell's work and gave only a plain statement of fact. A comparison of the following two statements will make this clear:

From Mitchell's paper[4], p. 333. "The energy of ethyl alcohol is to a large extent available for physiological purposes. Added to a complete diet such as milk it induces more rapid growth and greater retention of nitrogen as well as fat."

From my book, p. 136. "Dr. H. H. Mitchell . . . found that rats fed on a diet adequate in the known nutritional factors and to which a small daily allowance of alcohol had been added, grew faster and retained fat and nitrogen to a much greater extent than other animals which received the diet without the alcohol."

G. BOURNE.

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Oxford.

[1] Bourne, G., "Nutrition and the War", second edition (Cambridge University Press, 1942).
[2] Kon, S. K., NATURE, 149, 453 (1942).
[3] McCance, R., and Widdowson, E. M., *Special Report*, No. 235, *Med. Res. Coun.* (1940).
[4] Mitchell, H. H., *J. Nutrition*, 10, 311 (1935).

(1) I STILL feel that, in a popular book on nutrition, great care should be exercised in giving the reader guidance on the best choice of practical sources of supply of different nutrients, and I still think that Dr. Bourne's tables do not give such guidance. The value of curry powder as a practical source of iron for the population of Great Britain is, in my opinion, nil.

(2) The food value of ethyl alcohol. Mitchell's experiment showed that when alcohol was added to a certain diet its energy was available for physiological purposes, but that it was only three quarters as available as that of a similar supplement of sugar, which caused greater retentions of nitrogen and energy. Dr. Bourne's description makes no mention of the comparison of alcohol and sugar and conveys the impression that alcohol exerts a specific beneficial effect on the deposition of fat and utilization of food nitrogen. It tells the truth but not the whole truth, and in this way it certainly misinterprets Mitchell's findings.

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Amino Acids and the Human Being

THE satisfaction which may quite legitimately be felt in the logical and painstaking work which enabled Rose to classify the amino acids into essential and non-essential groups rather dims the realization that his classification only refers to the needs of the growing rat. In his recent communication to NATURE, Mr. Bacharach[1] gives a welcome jolt to the complacent attitude, so easily adopted, of assuming that what is true of the growing rat is true not only of the adult rat, but also of other species of animals. The work of Wolf and Corley[2], and of Burroughs, Burroughs and Mitchell[3], has shown, however, that the amino acids required to maintain nitrogen equilibrium in the adult rat are not entirely the same as those needed to make the young rat grow. These results illustrate the necessity of qualifying the term 'essential' when it is applied to amino acids.

Although about six years have elapsed since Rose made his classification of amino acids into essential and non-essential groups, our knowledge of the requirements of other species of animals is distressingly meagre. The sum total of our knowledge appears to be that the adult dog probably requires the same amino acids as the adult rat for the maintenance of nitrogen equilibrium, that in the regeneration of plasma protein in dogs with experimental hypoproteinæmia, cystine, leucine and glutamic acid are of primary importance, that the chick requires tryptophane, histidine, methionine, and (most surprisingly) glycine for growth and arginine for both growth and maintenance, and that lysine is required by cattle for both maintenance and milk production. What other amino acids are required by the chick and by cattle have not been elucidated.

Mr. Bacharach points out that it would be interesting to know what evidence there is indicating the indispensability or dispensability of individual amino acids for humans. At the end of last year Holt and his co-workers[4] showed that human subjects on diets deficient in tryptophane or lysine develop negative nitrogen balances which can be restored to normal by supplying the specific amino acid. No other evidence of this nature exists so far as I am aware: indeed only Sharpenak and his colleagues[5] have hitherto shown any active interest in the question of the amino acid composition of human flesh, and of the combination of natural foodstuffs which would supply these amino acids in the required proportions. It is unfortunate that although more refined methods are now available for the determination of amino acids in proteins, no further work has been done on these lines.

Supplies of protein foods for both the human and the stock populations of Great Britain are limited, and this limitation will continue after the War. For the most economical use of these supplies it is obviously of the utmost importance for us to determine as rapidly as possible the qualitative and quantitative amino acid requirements of farm animals and man.

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May 15.

[1] Nature, 149, 473 (1942).
[2] *Amer. J. Physiol.*, 127, 589 (1939).
[3] *J. Nutrition*, 19, 363 (1940).
[4] *Proc. Soc. Exptl. Biol. Med.*, 48, 726, 728 (1941).
[5] *J. Physiol.* (U.S.S.R.), 17, 170 (1934).

Ancestry of Captorhinomorph Reptiles

In a review of Tetrapod origins[1] I have mentioned certain results of comparisons of early Reptilia and Amphibia of which a full account must await less abnormal circumstances. Meanwhile it seems desirable to outline some of the conclusions.

The Seymouriamorpha and Diadectomorpha, reptiles of Permian age, are often considered to include ancestors of the other reptilian groups. But the geological history of the Captorhinomorpha and their Pelycosaur relatives goes back well into the Stephanian[2], and Captorhinomorphs may possibly include also the ancestors of Diapsid reptiles. It is therefore of considerable interest that they cannot be derived from Seymouriamorphs, nor apparently from Diadectids.

The well-known Captorhinomorphs are comparatively late (Captorhinus, Labidosaurus are Clear Fork = Artinsk). They have very specialized temporal regions, and the bone nomenclature is controversial. But Pelycosaurs, which are certainly derived from early Captorhinomorphs, show a primitive condition (seen also in Diadectes, etc.) in which the supratemporal lies in the skull-table and meets the postorbital; the supratemporal also turns down to lie near the paroccipital process, from which it is separated by the tabular, here a bone of the occipital surface[2]. Comparison of the series Ophiacodon—Eothyris (both Pelycosaurs)[2]—Protorothyris—Romeria (both Captorhinomorphs approaching Pelycosaurs)[3]—Captorhinus shows that the supratemporal is easy to follow throughout. In Captorhinus it is the small flake on the skull-table, often called tabular; in Labidosaurus Williston shows the bone to be absent. In both forms the tabular, if present, must lie on the occipital surface. It is clear that the supratemporal is greatly reduced in the late Captorhinomorphs; early members should have had large supratemporals meeting the postorbitals, with tabulars and postparietals (= dermosupraoccipitals) on the occipital surface, and the otic notch largely obliterated by downward rotation of the paroccipital process, tabular and supratemporal. Such a type could be ancestral to known Captorhinomorphs and Pelycosaurs, and is in sharp contrast to Seymouriamorphs. The Diadectomorph structure is not dissimilar.

This primitive Captorhinomorph structure compares exactly with that of the uppermost Westphalian "Adelospondyl Amphibian" Microbrachis and its apparent relative Hyloplesion (which shows that the bone in Microbrachis called 'tabular' is the supratemporal[4]), and with no other known Amphibia. These forms show marked resemblance to Captorhinomorphs in the structure of the whole skull and palate, rather similar vertebræ, ossified caudal intercentra bearing hæmal arches (unossified intercentra may possibly have occurred elsewhere), somewhat similar arrangement of ribs, etc. The limb skeleton is not too well known in the Nýřany Microbrachids, where the hand is apparently reduced to three digits. The digital formulæ of the feet of Microbrachis and Hyloplesion are 2, 3, 4, 4, 3 and 2, 4, 5, 3, 1 respectively. It is clear that these forms are too specialized (degenerate ?) to be actual Captorhinomorph ancestors; but it is highly probable that the contemporaneous Linton (Ohio) forms *Tuditanus punctulatus* (Cope) (= *Eosauravus copei* Will.) and *Eusauropleura digitata* (Cope)[5] are closely related to them (they correspond well in other ascertainable characters to Microbrachids) and these show respectively the digital formulæ (foot), 2, 3, 4, 5, 4 and (hand) 2, 3, 4, 5, 3. Several other Microsauria show remarkably reptile-like characters, involving limb-girdles, vertebral structure, hæmal intercentra, presence of entepicondylar foramen in humerus, etc. (for example, Hylonomus, Fritschia)[6].

It seems very probable, therefore, that the ancestry of the Captorhinomorpha is to be sought among small Carboniferous vertebrates which Moodie would have included in his Microsauria and are now usually regarded as Adelospondyl or Lepospondyl Amphibia. (Recent experience has made the neurocentral suture an unreliable character for separating Adelospondyli and Lepospondyli[7].) Moodie, long ago, suggested that *all* reptilia originated from the Microsauria, a view held by others of the older workers, and Goodrich also noted reptilian characters in the caudal intercentra of Hylonomus, and regarded the Microsauria as reptiles. The remarkably annectant characters of Seymouria have diverted attention from the smaller forms, and Seymouria was certainly derived from Anthracosaurid Embolomeri[8]. Diadectes seems to be a somewhat isolated type, of which the ancestors cannot yet be indicated, though in many details it resembles Captorhinomorphs. The cranial pattern and general similarity of body structures show that Seymouriamorphs, Captorhinomorphs and Diadectomorphs could only be derived ultimately from Anthracosaur-like Stegocephalia. Pantylus, as suggested by Säve-Söderbergh, should be removed from Cotylosauria; I hope to comment further on this interesting form and its relatives.

The Cotylosauria may therefore be regarded as springing ultimately from a fairly well-defined stock, but the differentiation along at least two of the three main lines occurred while the animals were still technically Amphibia. Säve-Söderbergh's term Reptiliomorpha[9] is useful to cover the Anthracosaurs and the Cotylosaur groups, and should also include the smaller animals discussed above; some of the other Carboniferous smaller Amphibia (Nectidia, Aistopoda) may possibly be nearly related.

T. S. WESTOLL.
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May 19.

[1] *Biol. Rev.* (in the press).
[2] Romer and Price, "Review of the Pelycosauria", Geol. Soc. Amer. Spec. Papers No. 28 (1940).
[3] Price, L. I., *Proc. New Zealand Zool. Club*, **16**, 97 (1937).
[4] Steen, M. C., *Proc. Zool. Soc. Lond.*, **108**B, 205 (1938).
[5] Romer, A. S., *Bull. Amer. Mus. Nat. Hist.*, **59**, 77 (1930).
[6] Steen, M. C., *Proc. Zool. Soc. Lond.*, 1934, 465 (1934).
[7] Moodie, R., *Geol. Mag.*, **6**, 216 (1909).
[8] White, T. E., *Bull. Mus. Comp. Zool. Harv.*, **85**, 325 (1939).
[9] Säve-Söderbergh, G., *Medd. Grønland*, **98**, Nr. 3 (1935).

Mitotic Divisions following Meiosis in *Pediculus corporis* Males

MANY years ago one of us[1,2] found that the offspring of single-pair matings of the body louse, *Pediculus corporis*, are often all of one sex, and that even when both sexes are represented among the offspring of one pair there may be a significant preponderance in the numbers of one or the other sex. Data since collected have confirmed and extended these observations, and also shown that differential mortality does not account for these unusual sex ratios, but hitherto no satisfactory explanation has been found of the method of sex determination. During our attempts to find out the mechanism involved, the process of spermatogenesis has been reinvestigated, and the results obtained, although at present throwing no light on the main problem, seem of sufficient interest to be recorded.

In *P. corporis* the somatic cells of both sexes, and also the oogonia and spermatogonia, contain six pairs of extremely minute chromosomes. So far as can be seen, five pairs have a median, and one a terminal centromere. We have not been able to distinguish any dimorphic pair.

In the embryo meiosis starts before hatching and continues at least during all three nymphal stages; spermatogonial divisions can be seen throughout the same period. It will be understood from what follows why meiotic divisions, as well as spermatogonial divisions, are so rare as to have escaped notice by previous workers[3,4].

The spermatogonia ($2n = 12$) undergo meiosis singly without the preliminary growth-phase usually occurring in spermatocytes. There are five bivalents and two univalents in the first division. The second division, even more rarely seen than the first and therefore very rapid, in the metaphase plate shows six chromosomes, five arranged peripherally, and one in the centre. This arrangement is repeated in the five subsequent mitoses described below.

The four haploid products of meiosis, each much smaller than the original spermatogonium, undergo four successive mitotic divisions in perfect synchronization, forming successively cysts of 8, 16, 32 and 64 cells. After the 64-cell stage has been reached, a certain amount of growth takes place and a large spherical mitochondrial body makes its appearance. A fifth mitosis follows, of a very peculiar type, accurately described by Doncaster and Cannon[3,4]. One of the daughter nuclei with very little cytoplasm and no trace of the mitochondrial body is extruded at telophase; while the other daughter-nucleus, together with practically all the extra nuclear material, including the mitochondrial body, begins its transformation into a spermatozoon. Hence there are only 64 spermatozoa in each bundle.

It will be seen, therefore, that in Pediculus the phase of multiplication of the germ cells which usually precedes meiosis takes place in part after meiosis; in other words, meiosis is pushed back in the development of the germ track. So far as we are aware, the only comparable case known among the higher animals and plants is that of the haploid testes in the diploid hermaphrodite coccid, *Icerya purchasi*.

Department of Zoology, University of Glasgow.
May 26.
E. HINDLE.
G. PONTECORVO.

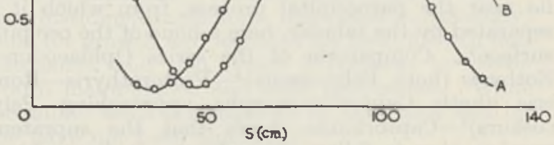
[1] Hindle, E., *Parasitology*, **9**, 259 (1917).
[2] Hindle, E., *J. Genet.*, **8**, 267 (1919).
[3] Doncaster, L., and Cannon, H. G., *Quart. J. Micro. Sci.*, **64**, 303 (1920).
[4] Cannon, H. G., *Quart. J. Micro. Sci.*, **66**, 657 (1922).

Input Impedances of Vacuum Thermo-junctions at Ultra-High Frequencies

THE method of analysing impedances at ultra-high frequencies using Lecher wires, recently described by Flint and Williams[1], has been used to examine a number of thermojunctions the D.C. heater resistances of which varied between 100 and 1,600 ohms. The frequency employed was approximately 150 Mc./sec.

The input impedances were measured with the junctions mounted in pin bases secured in valve-holders and also when demounted and connected directly to the Lecher wires. The latter method removed the substantial capacitative effect inherent in the external mounting but left the capacities within the pinch and also the self-capacity and self-inductance of the spiral filament. At the above frequencies these residuals have an admittance comparable with that of the filament.

If the thermo-junction is used to terminate the transmission line, a change in its reactance will change the phase angle in the reflexion coefficient. This will be accompanied by a shift in the standing wave system which is set up.



The shift produced by demounting a junction (D.C. filament resistance, 1,500 ohms) is shown in the accompanying figure. Curve *A* was obtained with the junction mounted and curve *B* when demounted.

Calculations for the various junctions available are summarized in the table below. *R* denotes the D.C.

D.C. Resistance R (ohms)	H.F. Series Components				H.F. Parallel Components				M_p (pf)	N_p
	R_s (ohms)		X_s (ohms)		R_p (ohms)		X_p (ohms)			
	Mounted	Demounted	M	D	M	D	M	D		
90	105	—	+76	—	160	—	+ 221	—	—	—
410	414	540	−13·7	+ 69	414	549	−1250	+4300	1·03	4·6 μH.
1500	320	994	−439	−394	922	1150	− 673	−2900	1·21	0·36 pf
1600	335	1140	−432	−570	892	1425	− 692	−2850	1·16	0·37 pf

resistance of the filament; R_s and X_s are the series resistive and reactive components of the input impedance, while R_p and X_p are the equivalent parallel components; M_p denotes the capacity introduced by the mounting and N_p the net residual inductance or capacity of the demounted junction.

These results show:

(1) That the residuals in this type of junction are inductive for low values of R (X is positive), but are capacitative for the higher values (X is negative). This is believed to be a net effect with the self-capacity increasing more rapidly with the length of the spiral than does the self-inductance. Thus for the junctions of higher resistance this increased self-capacity more than nullifies the rise in the resistive component due to the skin effect and to the self-inductance. For these, R_p is less than the D.C. value.

(2) That the demounting of the junction corresponds to the removal of a shunt capacity of approximately 1·1 pf., leaving only the residuals.

They demonstrate, therefore, the importance of an individual analysis of a thermo-junction if it is to be successfully matched into any circuit.

The current responsible for heating the filament is a fraction of the total current through the junction assembly. This fraction depends on both the applied frequency and the construction of the junction, but our results indicate that it is independent of the magnitude of the current. The response of the junction at ultra-high frequencies is thus proportional to the D.C. calibration curve, which may, therefore, be used in the interpretation of radio-frequency currents. This calibration curve is rarely linear, so that for accuracy reference should always be made to it.

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GORDON WILLIAMS.

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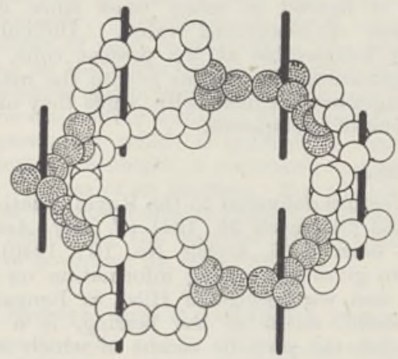
[1] Flint and Williams, *Phil. Mag.*, (7), **32**. 489 (1941).

Open Packing of Spheres

TAKE four equal spheres with diameter d and place one at each vertex of an equilateral triangle the sides of which are $2d \cos 30°$ in length: the fourth sphere placed at the centre of the triangle will make contact with the first three. Call this set of four spheres a structural unit. Next draw a regular hexagon with sides $2{\cdot}5d$ in length. At alternate vertices of the hexagon place a structural unit with its centre coinciding with the vertex, and two lines of centres from the middle sphere coinciding with two sides of the hexagon. Construct a second sheet of units with their centres over the remaining vertices of the hexagon, corresponding lines of centres overlying the remaining sides of the hexagon. Add a third sheet the same as the first and overlying it: and a fourth the same as the second overlying the second, and so on.

In the resulting structure (which has a density of 0·149) the lines of centres from any sphere to those touching it make angles of 120°, and therefore Heesch and Laves's *Ersetzungsprinzip*[1] can be applied to it. This consists in substituting a group



of three spheres (in mutual contact) for every sphere in the original structure. In this way we arrive at the system shown in the accompanying figure. This structure has a density of 0·045 and a higher degree of homogeneity than that recently described[2].

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[1] Heesch, H., and Laves, F., *Z. Krist.*, **85**, 443 (1933).
[2] Melmore, S., NATURE, **149**, 412 (1942).

Catalytic Dimerization of Isobutene by Activated Copper Sulphide

IN previous communications[1] it has been shown that copper sulphide, activated by oxidizing a part of its surface into copper sulphate, is a catalyst for the low molecular polymerization of isobutene. It has now been found that the main product of the catalytic process is a mixture of the two 2 : 2 : 4-trimethylpentenes which on hydrogenation were converted into 2 : 2 : 4-trimethylpentane. This latter compound was identified by determining the boiling point, the specific gravity, the refractive index, the melting point and the mixed melting point with an authentic sample. A detailed description of the experiments will be published elsewhere.

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London, S.W.7.

[1] Wassermann, British Patent 499953; Ingold, E. H., and Wassermann, A., *Trans. Farad. Soc.*, **35**. 1022 (1939).

RESEARCH ITEMS

Fruitflies of the Genus Anastrepha

MISCELL. PUB. 839 of the United States Department of Agriculture (Washington: Govt. Printing Office. 40 cents) is devoted to the above subject. In about a hundred pages the author, Alan Stone, contributes a more or less complete systematic monograph on the genus in question. Certain of its species in their larval stages damage the fleshy parts of subtropical and tropical fruits of various kinds. Six species are at present recognized as being of major economic importance in the western hemisphere, where they damage such fruits as citrus, mango, guava, peach, etc. The range of the genus is from South America, into tropical Central America and the West Indies together with southern Florida; also a few species are Mexican. The author recognizes 126 presumably valid species, and in the accompanying key the females only are dealt with. The apex of the ovipositor is figured in many cases since it affords characters of recognized value. Difficulties, apparently insuperable at the present time, preclude the preparation of a similar key to the males. The early stages are not dealt with, since they are known for so few of the species.

Indian Fishes

IN a lecture delivered to the Royal Asiatic Society of Bengal on March 25, 1941 (*J. Roy. Asiatic Soc. Bengal*, Science, 6, Article No. 10; 1940), Sunder Lal Hora gives interesting information on the life-history and wanderings of Hilsa in Bengal waters. *Hilsa elisha*, allied to the herring, is a valuable marine fish the periodic ascent of which into fresh waters has earned it the name of the Indian shad. Dr. Hora has already published papers on his researches on the spawning grounds and bionomics of this fish (*Rec. Ind. Mus.*, 40, 42), but the present paper is valuable in bringing together in simple language all that is known, with comments on the fishery. It is only quite recently that it was found positively that Hilsa spawns high up in the rivers. A series of papers on fishes by the same author is published in the *Records of the Indian Museum* (43, Part II; 1941), in the *Journal of the Bombay Natural History Society* (42, No. 2; 1941) and the *Journal of the Royal Asiatic Society of Bengal*, Science, 6; 1940, 1941). These include descriptions of the freshwater fish of Travancore and a continuation of former work on the same fishes of India.

Intertidal Sand Fauna

E. EMRYS WATKIN ("The Macrofauna of the Intertidal Sand of Kames Bay, Millport, Buteshire" *Trans. Roy. Soc. Edinburgh*, 50, Part II, No. 16; 1942) has continued the studies carried on by Elmhurst and Stephen (1928–31) and now attempts a more precise statement of the zonation by fixing stations at much narrower intervals, actually 5 yards apart, giving 42 stations over a horizontal range of 210 yards, from high-water spring tides to low-water spring tides. The groups of animals represented are chiefly Crustacea and Polychæta and the very abundant lamellibranch *Tellina tenuis*. On the whole, the Crustacea are more sharply zoned than the Polychæta, with each species showing a more definite centre of abundance. Compared with other bays, the zonation is usually similar, although a few definite exceptions occur. Special attention is paid to the size of the soil particles, and a mechanical analysis is made of these which shows that the soil is very even over the whole tidal range, with particles of a size 0·2–0·5 mm. accounting for more than 80 per cent of the samples. Comparison with the analysis of soils by other workers shows that this composition carries high population densities. The author points out that the grade composition of the soil appears to affect density directly, but it cannot account to any extent for the zonation of the organisms, and the factors governing zonation are still problematical and differ from species to species.

Relative Firmness of Pig Back Depot Fat

IN a paper by W. Bolton and R. G. Baskett read at a meeting of the Society of Public and Other Analytical Chemists on May 6, the iodine value as an index of the relative firmness of pig back depot fat was considered. For pig back depot fat a close correlation was found to exist between the iodine value (Wijs) and the firmness as measured by means of the grease penetrometer of the Institute of Petroleum. The firmness measurements were carried out at 30·5°, 32·0° and 46·5° F., at which temperatures the average depths of penetration were 4·5, 6·4 and 15·3 mm. The correlation coefficients between iodine values and depths of penetration were + 0·9564 (23 samples) at 30·5°, + 0·8543 (28 samples) at 32·0°, and + 0·7136 (28 samples) at 46·5° F. In laboratories where the close temperature control necessary for penetrometer or similar direct tests of firmness are impracticable, the iodine value will give a more accurate measure of the firmness of these fats.

Temperature and Sex Ratio in *Drosophila pseudo-obscura*

MALES of *Drosophila pseudo-obscura* and several other species of Drosophila exhibit the genetical character 'sex-ratio' by giving more than 90 per cent females in their progeny, no matter what female is used as mate. C. D. Darlington and Th. Dobzhansky (*Proc. Nat. Acad. Sci.*, 28, 45; 1942) give evidence which suggests that the X-chromosomes in these males divide twice instead of once at meiosis. As a result the majority of the spermatids contain an X-chromosome. The abnormal behaviour induced by a gene appears to depend on an excessive charge of nucleic acid, and, therefore, the authors expected the effect could be influenced by temperature as in other organisms. They find that there is a significant increase of males in the progeny of males kept at 16° C. as compared with those kept at 25° C.

Rainfall in South Madras

SCIENTIFIC Note No. 98 of the India Meteorological Department by V. Doraiswamy Iyer is devoted to the forecasting of the north-east monsoon rainfall of the south of Madras by the methods developed by Walker and others. The south-east of India, which is agriculturally important, receives comparatively little rain in the main wet monsoon period, June–September, and gets the bulk of its annual fall during October, November and December, when the south-west monsoon is retreating from India and when the rain-bearing winds on the Coromandel coast are north-easterly winds that have passed round the seasonal low-pressure area south of the Bay of Bengal. The formulæ developed in this investigation were arrived at after preliminary studies of the correlation coefficients between the rainfall of these months in the different sub-divisions of the province of Madras had shown that the south-east of Madras and Malabar can usefully be combined into a single region for forecasting. The rainfall of this region, which may be called "South Madras" was then studied in relation to various meteorological elements at action centres in other parts of India and further afield, and the formula arrived at was :

South Madras Rain = − 0·39 (S. America pressure June–Aug.) − 0·38 (Bangalore westerly winds at 3–5 km. height, Sept.) + 0·21 (Agra westerly winds at 5–8 km. height, Sept.)

This formula has a multiple correlation coefficient of 0·60. The formula for south-east Madras rainfall alone, using the same variables, was found to have only slightly different numerical factors, these being −0·38, −0·37 and +0·22, and, as was to be expected, the multiple correlation coefficient is nearly the same, being 0·59. Graphs of actual and calculated falls during 1914–1940 are given, followed by a discussion of the meteorological peculiarities of some of those seasons when the agreement between the two curves was not good. One might reasonably suppose that a study of such forecasting failures, if certain abnormalities of the meteorological regime were found to be a recurrent cause of failure, would give an indication of one or more additional variables that should have been included in the formula, but this enticing line of inquiry was apparently not followed up.

Extra Reflexions of X-Rays from Diamond

New experimental facts about the reflexions of X-rays by diamond have recently been published with reproductions of the X-ray photographs by Kathleen Lonsdale (*Proc. Roy. Soc.*, A, 179, p. 315 ; 1942). Two kinds of extra reflexions can be seen on well-exposed Laue photographs. All diamonds show *primary* diffuse reflexions, which are temperature-sensitive but not structure-sensitive. Type I diamonds, only, show *secondary* reflexions (sharp spots, streaks and groups of spots which are not at all typical of diffuse spots in general). They are no more than slightly, if at all, temperature-sensitive and are strongly structure-sensitive. *Primary* and *secondary* reflexions have been observed for many diamonds and in various orientations, associated with the {111} {220} {113} {331} Laue reflexions, using filtered and unfiltered radiation from copper and iron targets. No adequate explanation is yet available of the *secondary* reflexions, taking into account their structure-sensitiveness, the presence of {220} spots and the apparent incompleteness of the groups of spots actually observed.

Space-Charge and Electron Beams

An informative article by D. P. R. Petrie (*Electrical Communication*, 20, No. 2 ; 1941) on the effect of space-charge on the potential and electron paths of electron beams presents the more important results of analyses of space-charge in electron streams collected from existing literature, giving them in the form of curves and nomograms suitable for ready application in practice. The effects considered are the space-charge limited current in plane and cylindrical diodes ; the minimum potential ; maximum current and increase of transit time in the screen - anode region of tetrodes ; and the minimum potential, maximum current, velocity distribution and divergence of a long, flat beam between parallel plates and of a long, cylindrical beam in a tube. When an electron stream passes through an electrode system, the potential at any point is lower than that due to the electrodes themselves in the absence of current owing to the surrounding space-charge. In practice, this depression of potential has three important effects : (*a*) the potential may drop to zero at some point, forming a virtual cathode, some electrons being brought to rest there and returning to the nearest positive electrode ; (*b*) a beam which would be homogeneous in velocity is rendered inhomogeneous because the potential is depressed by different amounts in different parts of the beam ; (*c*) electric fields may be introduced altering the electron paths ; for example, an otherwise parallel beam is caused to diverge by its own space-charge. It is important for design purposes to be able to calculate the magnitudes of these effects due to a given current in a given electrode system, but this is possible only in a few cases of simple geometry. Examples are given to indicate the usefulness of such calculations. The possibility of bringing all the indicated results within the scope of a single paper is simplified by the universal appearance in the analyses of a certain fundamental dimensionless parameter which is defined in terms of a current density, a length, a potential, and the ratio of charge to mass of an electron. For completeness, the case of the space-charge limited diode has been included, this being the simplest system the action of which is governed by space charge.

Profiles of Hydrogen Lines in Two Class B Stars

A. Vibert Douglas and D. C. West have compared the theoretical line widths computed by Verweij with profiles of certain Balmer lines in spectra of γ Pegasi and ι Herculis (*Mon. Not. Roy. Astro. Soc.*, 102, 1 ; 1942). The observational data display marked contradictions, and these show how great are the uncertainties introduced by the method of calibration of a spectrum and the construction of the intensity profile from the microphotometer trace. The material forming the basis of the paper comprises seven 3-prism spectrograms of γ Pegasi and one 1-prism and four 3-prism spectrograms of ι Herculis. From these, microphotometer traces were made and intensity profiles were constructed from the wedge calibration on each plate by means of the reduction data of C. S. Beals (*Pub. Dom. Astrophys. Observ.*, Victoria, B.C. (vi), 9, 98–101 ; 1934). The actual profiles and also the theoretical profiles of Verweij are plotted and many interesting comparisons are made, very marked discrepancies occurring in some cases. Comparison is also made regarding total absorption in five Balmer lines, and the temperature corresponding to the values of total absorption for $H\beta$, $H\gamma$, $H\delta$ is from 19,000° to 21,000°, though it should be pointed out that these figures were obtained by "making a risky extrapolation". The percentage absorption at line centre is shown in a table and compared with the values obtained by C. T. Elvey and E. G. Williams. An editorial note points out that the hydrogen profiles predicted by Verweij's theory, with which the observations of the paper are compared, are based on Pannekoek's calculated values of the continuous absorption coefficient k (*Pub. Ast. Inst. Amsterdam*, No. 4 ; 1935). Pannekoek has revised these values since, the revised figures appearing in an addendum to the paper referred to.

FORESTS OF NEW ZEALAND

IN the opening pages of the annual report of the New Zealand State Forest Service for the year ending March 31, 1941, by Mr. Alex. R. Entrican, director of forestry (Govt. Printer, Wellington; 1941), presented to both Houses of the General Assembly, a résumé is given of a broad-based and wide-visioned forest policy. The aims laid down are the more significant in that they are expressed with a full knowledge of the calls which the War is making on the forests and the forest service of the Dominion.

On the subject of forest policy, which demands the widest foresight in modern warfare, it is stated that the State Forest Service is rapidly attaining a full war-time footing. As never before, war has reduced all forest issues to one simple problem, that of meeting an increasing and ever-changing demand for timber. Month by month this has claimed more and more of officers' time until in some instances their peace-time activities have been reduced to vanishing point. To conserve man-power, continuation of this trend is inevitable, and the Department's programme of work is being re-oriented accordingly. Fire protection, timber appraisal and utilization activities with their direct contribution to essential war-time production have been intensified, but with two exceptions all other activities either have been or are in course of being reduced to a mere skeleton basis. The two exceptions are staff training and planning, upon which the whole resources of the Department surplus to the war effort must be concentrated.

Prior to the appointment last year of additional technically trained personnel and their assignment to sylvicultural and forest-management duties, it was realized that more particularly in the State exotic forests some losses must be anticipated due to haphazard planning and lack of trained staff over a long period of years. Even prior to the great depression, organization and personnel were entirely inadequate to the Department's rapidly increasing responsibilities, and both the depression and post-depression periods have served to accentuate the disparity between volume of essential work and available trained staff. The seriousness of the position can no longer be ignored, and any attempt to correct it merely by intensification of current training methods must fall far short of minimum requirements. Although military service precludes the training of an adequate junior staff at present, such temporary arrangements as have proved possible have been made, including the establishment of a forest ranger school. It is hoped that at the end of hostilities a number of scholarships in overseas universities will enable forest officers now on military service to qualify for professional duties.

Perhaps the three major forestry preoccupations of the present time are connected with the indigenous forests, the artificially formed exotic forests and erosion. The general forest inventory carried out during 1921–25 demonstrated the necessity for establishing a capital forest resource of exotic softwoods to supplement declining supplies of native timbers until such time as the indigenous forests, which in the past had had to bear the lumbering operations connected with the opening out of lands for farming purposes accompanied by wasteful fellings and fires, could be brought into full productivity. The vital present necessity is the organization of immediate future supplies for the industry not so much for the war period as for its aftermath, when demand, it is expected, will expand on a considerable scale. A five-year programme of forest development for both Kauri and white pine has been prepared and a survey of standing rimu supplies is in progress. It is suggested in connexion with the indigenous forests that consideration will have to be given to the control of fellings on privately owned forest land with the view of conserving supplies and keeping the land reasonably productive, not ignoring the cogent objective of maintaining an effective vegetative cover in the interests of counter-erosion.

On the subject of the private and State exotic forests the report is illuminating. A grave warning on their poor condition was given in the previous year's report. While interim experience has served to confirm the worst fears in respect of faults of establishment due to the excessive annual areas afforested on inadequate knowledge of locality factors, etc.—wide espacement, choice of wrong species and sites, general location, etc.—the indications are that no less trouble is likely to arise through long-continued neglect of sylvicultural operations. Both threaten the health and vigour of many stands, some of which may be affected to such an extent as to become potential focal points for widespread insect and fungal attacks of an epidemic character, and others in such a manner as to preclude both cheap logging and cheap and quick re-establishment by natural regeneration, thus necessitating slower, more costly and less effective re-establishment by planting. As the Director correctly states, though the financial authorities in many parts of the British Empire have proved hard to convince, "in the ultimate analysis, sylvicultural treatment is no less essential to the continued functioning of the forests than the regular supply of oil and grease to hydro-electric turbines". But this is impossible unless provision is made in the forest budget irrespective of whether the operations concerned will be remunerative or otherwise.

The question of soil erosion has been a subject of considerable public discussion; and it is admitted to constitute a serious threat to the success both of the general forest policy and to the future development of the saw-milling and allied forest industries. Ardent conservationists of the extreme type go so far as to claim that the more inaccessible forests still existing should be reserved from milling operations. "The Forest Service", says the Director, "continues to advocate a realistic approach to the problem of soil-erosion through Dominion-wide control of land-burning operations. No other measure can give such effective results either as quickly or as economically. A conservative estimate of its effectiveness is placed at 80 per cent of the theoretical maximum. So aggressive is the New Zealand vegetation that no ground is too barren to resist its invasion—that is, if burning is controlled. Too often observation of erosion is limited to pastured slopes heavily scarred or even deeply gullied without realizing that every forest-clad hillside bears scars and gullies, though many are so healed by the ever-invading vegetation as to defy casual detection. But whereas repeated and uncontrolled burning aggravates and perpetuates the one, controlled use of fire arrests and heals the other. Even much of the harmful effect attributable to overgrazing is a direct result of indiscriminate burning, and would therefore be corrected by control of firing operations. Simple as the premise is, it provides the most practicable and economic method of preventing accelerated erosion".

There are many parts of the British Empire where erosion in one form or another is becoming an ever-increasing danger to the means of livelihood of the populations, as is the case, for example, in large parts of Africa. The above remarks of the Director on a suggested method of control may be commended to the administrations concerned; in fact, the whole report—a war-time report—would repay a careful study by all having administrative responsibilities in connexion with the land and its well-being throughout the Empire.

MODERN DEVICES CONTROLLING ELECTRICAL CIRCUITS

A PROGRESS review on "Circuit-controlling Devices on Power Supply Systems" has been given by C. W. Marshall (*J. Inst. Elect. Eng.*, 89, Pt. 1; April, 1942). The review commences with a summary of the technical aspects of power circuit control, considered in three main sections: limitation of current amplitude, limitation of voltage, and making and breaking of circuits.

The paper then proceeds to illustrate what has actually been accomplished by reference to outstanding features of switchgear construction. Illustrated examples are given of a 0·4-kv., 600-amp. air circuit-breaker, a 0·4-kv., three-phase, 800-amp. rating, switchboard, an 11-kv., 750 Mva. metal-clad circuit-breaker, a five-panel assembly of 11-kv., 500 Mva., metal-clad switchgear with circuit-breakers of the draw-down type; the latter are fitted with arc-control devices. A pictorial sectional view of a modern switching unit is given, and shows *inter alia* the circuit-breaker, the means of connecting it to the busbars and to the outgoing circuit, and also the disposition of the current and voltage transformers.

A 33-kv. metal-clad switchgear is depicted, the busbar chambers in this case being filled with 'Freon' gas, and fitted with removable circuit-breakers. A third type of 33-kv. metal-clad switchgear is shown in which small oil-content type circuit-breakers are arranged horizontally. Two other small oil-content breakers are illustrated, one being an electrically operated type with a horizontal breaker, while the other has a vertically mounted breaker operated by compressed air. The last example of 33-kv. practice shows one of the most advanced and interesting designs which is available for commercial application. The general busbar structure follows standard metal-clad practice. The circuit-breaker, however, is of the air-blast type and this development is believed to be unique.

Two examples of 66-kv. switchgear are shown, the first being of the vertical type with double busbars and oil-immersed busbar selectors, while the second is a single-break, small-oil-volume, porcelain-clad unit. A group of 132-kv. units is shown, including a large-oil-volume circuit-breaker originally fitted with four open breaks and converted to a double-break type with arc control. Another illustrates the transition from the large-oil-volume circuit-breaker with steel tanks to the small-oil-volume, porcelain-clad type. A cross-sectional view illustrates all the essential parts of one phase of the breaker, and a photograph shows the complete assembly of a three-phase unit and offers a good idea of its size.

The practical performance of the various classes of installation is assessed, short-circuit test performance figures are given for typical circuit-breakers, mention is made of the test performance of modern fuses, and a tribute is paid to the remarkable efficiency of the various short-circuit testing stations. The period reviewed has been remarkable for the advance in knowledge of the intimate phenomena of arc rupture due to the fundamental research work of the British Electrical and Allied Industries Research Association, supplemented by the development work done in the various British switchgear testing stations.

A.R.P. AND THE ENGINEERING INDUSTRY

A CONFERENCE on air-raid precautions and the engineering industry arranged by the Institutions of Electrical, Civil and Mechanical Engineers with the co-operation of the Ministry of Home Security (Research and Experiments Department) was held at the Central Hall, Westminster, on December 9, and summaries of the three addresses delivered are contained in the *Journal of the Institution of Electrical Engineers* (89, Pt. I, April, 1942).

In an address on the "Effect of High Explosives on Structures", Prof. J. D. Bernal said that the main effects of explosions were covered by describing the arrival of the bomb or mine, and then the three chief mechanisms by which mines and bombs cause damage: blast; bomb fragments; earth shock when a bomb explodes in the ground. The distance a bomb travels before exploding is of more importance than the distance of penetration. This is determined not by the penetrating power but by the kind of fuse it carries. The distribution of fragments from a bomb exploding in air was explained to consist of three zones: those shot off at right angles to the side of the bomb, forming the main fragment zone; tail fragments, usually light; and nose fragments, usually heavy. The simple physics of the released gases was explained in connexion with peak blast pressure. An analysis was given of the reactions of a structure to blast, mention being made of the fact that resonance can be a contributory cause to damage if the half-period of the structure is of the same order as the time-interval between maximum pressure and maximum suction. The effects of shock waves from bombs exploding subterraneously were also described.

Prof. J. F. Baker dealt with the "Design of Protective Structures and the Defence of Industry" in an address which described principles of structural design for protecting industry from air attack which, though unfamiliar in normal engineering practice, can claim recognition as rational. Effective resistance was explained to be achieved by resistance accompanied by provision against failure by shear, while ductility in material and continuity in structural form combined with mass are essential if the structure takes the form of a wall. Recommendations were made for the protection of workers by shelters, and suggestions made as to a rationalized system of structural design for strengthening floors to carry loading by debris and for stability under earth shock. The criterion of proper protection was stated to be such that, having regard to war hazards, the total probable output over a period of all existing factories shall be thereby increased by a greater amount than if the work had gone into building new factories to be equipped with machine tools, the economic standard of protection depending ultimately on the scale of air attack.

A survey was made by J. W. Martin of the "Gas Contamination Problem in the Engineering Industry, with Special Reference to Electrical Machinery", and it dealt with the effects of gas contamination on the properties of materials and the functioning of machines, and with the consequent risk to workers operating the machines, or working near enough to be affected by vapour. Particular problems arise in connexion with the insulation of electrical machinery. An important factor in electrical work is the specific resistivity of liquid gases, owing to the danger of flashovers. It was concluded that the chances of contamination causing serious dislocation of industry are not high, and risks can be appreciably reduced by relatively simple means. Where contamination of plant occurs it need not mean the closing of works for long periods. It is advisable to replace the intricate and complicated instruments and components of plant that become contaminated. The emphasis should be on putting the plant into operation, contaminated work in progress being dealt with as a salvage operation.

FORTHCOMING EVENTS

(Meeting marked with an asterisk is open to the public)

Tuesday, June 16

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Dr. Alf. Sommerfelt: "The Social Origin of Linguistic Categories".

Wednesday, June 17

INSTITUTE OF CHEMISTRY (LONDON AND SOUTH EASTERN COUNTIES SECTION) (in the Chemistry Lecture Theatre, West Ham Municipal College, Romford Road, London, E.15), at 6 p.m.—Dr. H. Baines: "Recent Advances in Photographic Theory".

Thursday, June 18

CHADWICK PUBLIC LECTURE (at the Chelsea Physic Garden, Swan Walk, London, S.W.3), at 4 p.m.—Mr. E. Augustus Bowles: "Plants in relation to Food, Medicine or Poison".*

CHEMICAL SOCIETY, INSTITUTE OF CHEMISTRY AND SOCIETY OF CHEMICAL INDUSTRY (BRISTOL AND SOUTH-WESTERN COUNTIES SECTIONS) (in the University Chemical Department, Woodland Road, Bristol), at 6.30 p.m.—Mr. J. Lumsden: "Statistical Methods Applied to Chemical Problems".

Saturday, June 20

INSTITUTE OF PHYSICS (LONDON AND HOME COUNTIES BRANCH) (at the South-West Essex Technical College, Forest Road, Walthamstow, London, E.17), at 2.30 p.m.—Conference on "The Eye in Industry".

APPOINTMENTS VACANT

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

LECTURER (WOMAN) FOR GEOGRAPHY AND MATHEMATICS in the Crewe County Training College—The Director of Education, County Education Offices, City Road, Chester (June 18).

LAC INFORMATION OFFICER—The Central Register (Reference O.N.F. 547), Ministry of Labour and National Service, Sardinia Street, London, W.C.2 (June 20).

CHIEF LECTURER IN MECHANICAL ENGINEERING—The Principal, Walsall Technical College, Bradford Place, Walsall (June 20.)

ASSISTANT DAIRY BACTERIOLOGIST—The Registrar, The University, Leeds 2 (June 25).

LECTURER IN HIGH VOLTAGE ENGINEERING and an ASSISTANT LECTURER IN ELECTRICAL ENGINEERING—The Registrar, College of Technology, Manchester 1 (June 30).

LECTURER IN SCIENCE—The Principal, Domestic Science Training College, Knighton Fields, Leicester.

LECTURER IN BIOLOGY—The Principal, Bishop Otter College, Chichester.

TWO ANALYSTS—The Director of Research, Research Association of British Flour-Millers, Old London Road, St. Albans, Herts.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Geological Survey of Great Britain: England and Wales. Wartime Pamphlet No. 4: Water Supply from Underground Sources of the Oxford–Northampton District. Part 1: General Discussion. By Dr. A. W. Woodland; with a Contribution on Rainfall, supplied by the Director, Meteorological Office, Air Ministry. Second edition. Pp. 35. (London: Geological Survey and Museum.) 1*s*. 8*d*. [36

Reconstruction. Report by the Federation of British Industries. Pp. 31. (London: Federation of British Industries.) [36

British Rubber Producers' Research Association. Publication No. 16: Rubber, Polyisoprenes and Allied Compounds, 1: The Synthesis of Low-Molecular Polyisoprenes of the Rubber and the Squalene Type. By E. H. Farmer and D. A. Sutton. Pp. 6. Publication No. 17: The Course of Autoxidation Reactions in Polyisoprenes and Allied Compounds, 1: The Structure and Reactive Tendencies of the Peroxides of Simple Olefins. By E. H. Farmer and Alvappillai Sundralingam. Pp. 19. Publication No. 18: The Course of Autoxidation Reactions in Polyisoprenes and Allied Compounds, 2: Hydroperoxidic Structure and Chain Scission in Low-Molecular Polyisoprenes, by E. H. Farmer and D. A. Sutton; The Autoxidisability of the Alkyl Groups in Xylene, by E. H. Farmer and E. S. Narracott. Pp. 11. Publication No. 19: The Efficiency of Pneumatic Tyred Tractors under Farm Conditions. By E. W. Russell, H. J. Hine and B. A. Keen. Pp. 42+1 plate. Publication No. 20: The Interaction between Rubber and Liquids, 1: A Thermodynamical Study of the System Rubber—Benzene. By G. Gee and L. R. G. Treloar. Pp. 19. Publication No. 21: The Caoutchol Component of Natural Rubber; a Correction. By K. C. Roberts. Pp. 3. (London: British Rubber Producers' Research Association.) [46

Other Countries

Smithsonian Miscellaneous Collections. Vol. 101, No. 12: The Quantity of Vaporous Water in the Atmosphere. By C. G. Abbot. (Publication 3678.). Pp. ii+7. Vol. 101, No. 13: A New Titanothere from the Eocene of Mississippi, with Notes on the Correlation between the Marine Eocene of the Gulf Coastal Plain and Continental Eocene of the Rocky Mountain Region. By C. Lewis Gazin and J. Magruder Sullivan. (Publication 3679.) Pp. ii+13+3 plates. (Washington, D.C.: Smithsonian Institution.) [265

The Engineering Foundation. Annual Report, October 1, 1940, to September 30, 1941. Pp. 47. (New York: The Engineering Foundation.) [265

U.S. Department of Agriculture. Technical Bulletin No. 798: Relationship of Insects to the Spread of Azalea Flower Spot. By Floyd S. Smith and Freeman Weiss. Pp. 44. (Washington, D.C.: Government Printing Office.) 10 cents. [265

Forest Bulletin No. 103: Jute Cuttings for Paper Pulp. By M.P. Bhargava and A. N. Nayer. Pp. iii+5. 3 annas; 4*d*. Forest Bulletin No. 104: Studies on Coal Tar Creosote as a Wood Preservative, Part 1: Creosote Extracted from Timbers in Service. By D. Narayanamurti and V. Ranganathan. Pp. iv+18. 12 annas; 1*s*. (Delhi: Manager of Publications.) [265

U.S. Department of Agriculture. Circular No. 616: Methods of Breeding *Chelonus annulipes* on the Mediterranean Flour Moth for use against the European Corn Borer. By William G. Bradley. Pp. 23. (Washington, D.C.: Government Printing Office.) 10 cents. [285

U.S. Department of Agriculture. Farmers' Bulletin No. 1895: Land Slugs and Snails and their Control. By W. H. White and A. C. Davis. Pp. ii+8. 5 cents. Technical Bulletin No. 793: Evaluation of Baits and Bait Ingredients used in Grasshopper Control. By Robert L. Shotwell. Pp. 51. 15 cents. Technical Bulletin No. 797: Boron Distribution in Soils and related Data. By Richard R. Whetstone, William O. Robinson and Horace G. Byers. Pp. 32. 10 cents. (Washington, D.C.: Government Printing Office.) [295

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 44: The Manufacture of Insulation and Pressed Boards, Wrapping-Papers and Straw-Boards from Bagasse. By M. P. Bhargava and A. N. Nayer. Pp. iii+21+6 plates. (Delhi: Manager of Publications.) 1.4 rupees; 2*s*. [16

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