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Research and Finance

THE Parliamentary Science Committee has prepared a memorandum on the development and finance of the Department of Scientific and Industrial Research, including research associations. The memorandum is based upon a preliminary memorandum previously formulated by a joint committee of the British Science Guild and the Association of Scientific Workers. This joint committee may be regarded as the forerunner of the Parliamentary Science Committee, which is now, however, an independent body supported by a number of scientific institutions.

It is, of course, all to the good that a body, the membership of which embraces many distinguished scientific workers as well as industrialists, should devote its thought and energy to the question of how scientific research, and, perhaps, more especially, industrial research, in Great Britain should be developed and financed; but, equally of course, the Parliamentary Science Committee cannot claim to speak with paramount authority on this subject. Its views are its own, and the memorandum under consideration is to be regarded as its serious and constructive contribution to the general question stated above. The memorandum, when it is published in its final form, will no doubt be carefully considered, as it will deserve to be considered, by the Government and by such bodies as the Advisory Council of the Department of Scientific and Industrial Research, the Conference of Research Associations, the British Association, the Royal Society, and, it may be hoped, the Federation of British Industries—all of which having a direct interest in the subject matter of the memorandum, and each capable of contributing its own special knowledge and experience. We have been allowed to peruse the memorandum in its present form, and it may help to a constructive consideration of the very important questions raised if we endeavour to summarize briefly its argument and recommendations and to comment on them. We shall confine ourselves to the question of industrial research.

The memorandum starts by accepting as unquestionable the value of scientific research applied to the methods of industrial production, and pays ungrudging tribute to the work done by the research associations—numbering now some twenty—established under the scheme of the Department of Scientific and Industrial Research. "From six research councils only at the expense of less than £400,000 in all have come researches which have made possible a saving of £3,200,000 per annum. The aggregate saving from the work of all the Research Associations must be several times this sum and must represent a return on money invested of between 500 and 2,000 per cent."

Notwithstanding the demonstrated financial benefits that have resulted from scientific research, the problem of how to finance industrial research on a scale adequate for its maintenance and development is still acute. The real value of scientific research, whether pure or applied, is spread widely and can be financed only by finding an equally comprehensive basis for the collection of the necessary funds. Moreover, since one of the primary requirements of organised scientific research, and especially of industrial research, is that it should be prosecuted in a considered direction for a number of years, finance must provide for continuity.

The memorandum reviews briefly the methods adopted during the last eighteen years to finance the industrial research associations. At first it was

intended that, after an initial period, the research associations should be entirely dependent on the support of their respective industries. In order to set the associations going and to convince industry of the value of research, a grant of £1,000,000 was made by Government, and this fund was used to supplement the subscriptions of the industries on a £ for £ basis over this initial period, which was first sanguinely estimated at five years. This plan proved impracticable; the five years' period was extended to ten years, but, as the exhaustion of the million fund coincided with the depth of the industrial depression, it was decided that Government assistance should be continued on a different basis.

The grants in aid of the research associations now come from the sums annually voted by Parliament for the Department of Scientific and Industrial Research, and a new system—"the datum line system"—has been instituted. Under this system the Department gives grants to the research associations on a £ for £ basis in respect of all subscriptions raised above a certain fixed datum, considered necessary for the upkeep of the association on a minimum basis of efficiency. The datum varies with the industry concerned, and there is an upper limit to the Government grant, now fixed generally at three times the datum figure. Thus if the schemes were fully utilized, the relative share of the Government would be two fifths of the total income available for expenditure on research. Moreover, the principle of Government grants in aid of research is now, apparently, accepted as a permanent policy—at least as permanent as is, say, the principle of State aid for education.

The Parliamentary Science Committee's chief criticism of the existing system of finance is "the rapidly fluctuating amount of money available for research and the lack of provision for the steady development of scientific research in industry". Accordingly, the memorandum sets forth certain "proposals for finance". In effect, they are proposals for the permanent endowment of research. "The ultimate sources of money needed for research," the Committee states, "are Government and Industry," and it is suggested that *both* should contribute to provide this endowment.

Incidentally, we may point out here that, in the long run, Government money can come only from the pockets of the citizens and, therefore, ultimately, from industry. It may be convenient to speak of both Government and industry contributing, but it will be as well to keep in mind that in the real "ultimate sources" it is industry that will have to find the money. It will serve, however, to regard the contribution of industry to research as being the direct contributions of the individual firms concerned as members of the several research associations; and to regard the Government grant as being the indirect contribution of industry generally, in return for the fruits of research, of which the general consumer is in the long run the greatest beneficiary.

The Parliamentary Science Committee rejects the method of raising contributions from the several industries by a statutory levy (as is done, for example, in the case of the woollen industry) on the ground that "the effectiveness of the application of scientific research depends to a large extent on the voluntary character of the collaboration between industry and science". On the other hand, the Committee rejects the alternative system of voluntary contributions because it has "the double disadvantage of penalising those firms who contribute as against those who do not and affording an extremely irregular income for scientific research".

We think the Committee's objections to the method of raising funds for research by means of a statutory levy are sound. There may be a few industries in which it is practicable, but in many industries it would be impossible to decide which firms did and which did not fall within the ambit of the industry under levy. Moreover, it is certain that there would be widespread opposition to such a plan on the part of a very great number of industries. The need for voluntary collaboration between industry and science, if the application of scientific research to industry is to be effective, was recognized from the outset of the research associations' scheme, and was well stated in one of the early annual reports of the Department of Scientific and Industrial Research.

The argument that those firms which contribute to research associations are 'penalised' as against those who do not, seems to us entirely misconceived. Voluntarily subscribing member firms of research associations derive directly, from the research work carried out and in other ways, benefits which are not available to non-members. It is true that in the long run non-member firms must benefit, and that ultimately, as has already been pointed out, the consumer will be the major beneficiary, but at first and for a time the subscribing members of the associations must be

benefited and not penalized as against non-members. This must be a recurrent advantage with each successive discovery or advance, and is the main reason why members pay their subscriptions.

The argument that the system of voluntary contributions affords "an extremely irregular income for scientific research" has substance, but it can easily be pushed too far. Some fluctuations of income are inevitable in all organizations, whether devoted to scientific research or not, that are dependent largely for their income on voluntary contributions. It may be doubted whether the fluctuations of income in the case of the research associations, due to the voluntary character of the contributions from industry, are so "extremely irregular" as is suggested. The real trouble is not so much the magnitude of the fluctuations in the income from subscriptions, but the fact that the general average of the contributions is much too low, as the memorandum of the Parliamentary Science Committee recognizes. In any event, the fluctuations of income present a problem to the research associations not essentially different in character or, possibly, in extent, from that which individual industrial firms and whole industries have from time to time to solve. If the average income were enough, the fluctuations could well be managed, as similar irregularities are managed in business, by the building up and utilization of adequate reserve funds. These funds could well serve to 'iron out' irregularities in income. Scientific organizations in particular may be trusted to understand the functions of a fly-wheel. It seems to us that the Parliamentary Science Committee is prone to make too much of a bogey of fluctuations in income.

Having thus rejected both the statutory levy and voluntary contributions, mainly because they yield a fluctuating income, the Parliamentary Science Committee reaches, by an almost naïve logic, the conclusions that it is necessary to find some way of converting variable contributions into a fixed income and that this can be done only by the endowment of scientific research. Its proposal is "to set up a fund derived both from Government and Industry to provide a steady income sufficiently large for the basic needs of scientific research and for its expansion at a definite rate". The Committee estimates the amount required to be between £30,000,000 and £50,000,000, which might be raised immediately or by successive grants of two, three or four million pounds annually for a number of years. It is suggested, however, that the most equitable way of raising the sum would be to make it a charge on the revenue derived from the new Customs duties, such a compulsory grant to scientific research being regarded as compensation to the consumer for the loss of a free market.

"Once a Government contribution was assured, there would be no corresponding necessity for a steady contribution from industry," though the memorandum envisages contributions to the endowment fund from other sources, such as royalties from patents for the results of the work of the research associations and from statutory or quasi-statutory bodies.

Out of the annual contributions, raised as just indicated, and the interest on the sum already invested, the memorandum proceeds to say, "the current expenses for scientific research could be met according to a budget determined for some years ahead. In the end it would be hoped that science would be able to depend entirely on the interest from the fund and thus become independent of contributions from Government or Industry, although they might be required if any new developments on a large scale appeared to be necessary."

Such, stated very briefly (but not, it is hoped, so briefly as to be misleading), are the main features of the argument and proposals of the Parliamentary Science Committee for the establishment of a fund of, say, fifty million pounds, for the permanent endowment of scientific research, more especially in relation to industry.

The plan, it must be admitted, is both simple and bold. To many, indeed, it will seem grandiose. It would be impossible within the limits of a single article to examine adequately the proposals of the memorandum. But let us take one cardinal point. On what grounds is it possible to justify the removal from all Parliamentary control and criticism of the administration of essentially national funds raised by authority of Parliament? Suppose the argument to be applied to our national system of education, that, in order to secure stability and "to convert variable contributions into a fixed income", it must be permanently endowed and thus rendered independent of Government grants and, therefore, of Parliamentary control. What would be the likely response of Parliament or of the electors generally to such a proposal? To put it bluntly, are the proposals of the Parliamentary Science Committee 'practical politics'?

Again, suppose such a fifty millions fund to be raised from national resources for the permanent endowment of research. What is to prevent some future Chancellor of the Exchequer, in desperate straits to balance his budget, from raiding the research fund, as previous Chancellors have raided road funds or sinking funds? No Government can bind future Governments.

The question should be considered whether research could not better be permanently endowed by each research association building up its own reserve fund. A Chancellor of the Exchequer in a tight corner would find it more difficult to raid these several scattered 'nest eggs' than to pounce upon some big central fund. The Department of Scientific and Industrial Research should encourage the formation of such reserve funds by the research associations.

The root problem remains, of course, how to secure for the research associations increased financial support so as to give them assurance not only of life but also of an expanded and expanding life. We cannot enter into this question fully here, but one point may be stressed. It has already been pointed out that so-called "Government grants" to research associations are in the last resort the indirect contributions of industry. Government is prone to complain that industry is not making a sufficiently large direct contribution to research. Government has it in its power to increase the indirect contribution of industry by the simple device of increasing the Government grants in aid. Experience has shown that increased contributions from Government do lead to an increase in direct contributions from industry, not merely to the research associations as such but also to the individual research work of the firms concerned. Finally, we agree with the Parliamentary Science Committee that a great deal more might be done by means of organized education, publicity and propaganda to secure wider and increased financial aid for the research associations.

Theory of Elasticity

An Introduction to the Theory of Elasticity: for Engineers and Physicists. By Prof. R. V. Southwell. (Oxford Engineering Science Series.) Pp. ix+510. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 30*s*. net.

A CONSIDERABLE gap exists between the preparation in engineering mechanics which is usually given in engineering schools and the preparation required to read such fundamental books as A. E. H. Love's "Mathematical Theory of Elasticity" or Lord Rayleigh's "Theory of Sound". Owing to this gap, new developments in the theoretical sciences are very slow to find their way into engineering literature, and it sometimes happens that very powerful methods which could be utilized in solving engineering problems remain for many years without applications. A striking example of this situation is represented by Clerk Maxwell's important paper "On the Calculation of the Equilibrium and Stiffness of Frames" (*Phil. Mag.*, **27**; 1864). In this very condensed paper a general method of analysis of statically indeterminate trusses was developed for the first time. Although the problem of handling statically indetermined structures is of great practical importance, Maxwell's solution of the problem remained unknown to engineers until ten years later, when the method was rediscovered by O. Mohr (*Z. Architekten- und Ingenieur-Vereins zu Hannover*, p. 223; 1874), and put in the form which is now largely used in our theory of structures. Another example is represented by Rayleigh's method of approximate solution of vibration problems, which is so extensively and skilfully used by Prof. R. V. Southwell in the book under notice. Although the method was developed more than fifty years ago, its incorporation into English engineering books is a recent development.

Modern development of engineering is in the direction of more and more intensive utilization of pure science in solving practical problems. A designer interested in problems of strength of machine parts or engineering structures can no longer be satisfied with semi-empirical formulæ of strength of materials, and very often must go into a more refined analysis of stress distribution which can be done only by using the theory of elasticity. Under these conditions, engineers at the present time are becoming more and more interested in advanced study, and the purpose of Prof. Southwell's book is to provide the necessary preparation in the theory of elasticity required for reading more advanced books in that field.

The first three chapters of the book deal with problems which are usually discussed in books on

the theory of structures. The author, by using Hooke's law and the principle of superposition, develops such fundamental theorems as the reciprocity theorem and Castigliano's theorems. The importance of these theorems is illustrated by many interesting examples. There is given also a general proof of the principle of superposition which is based on the use of Hooke's law. However, since there are exceptional cases in which Hooke's law holds while the principle of superposition cannot be applied, it would seem more satisfactory simply to postulate the principle of superposition and limit the discussion to those problems where it holds. The third chapter of the book deals with 'self-strained' bodies and structures. These important problems are usually treated with great brevity in books on strength of materials, and engineers should be thankful to Prof. Southwell for his very complete presentation of this subject. Beginning with very simple problems, he finally develops the general theory for handling self-stressed systems and gives an original and very instructive proof of Castigliano's theorem of least work, which enables him to introduce an interesting discussion of Saint Venant's principle.

The following four chapters contain material usually treated in books on strength of materials. An elementary theory of stress and strain is given and also the application of this theory to problems of torsion and flexure. It seems that in this place also the Mohr circle might have been discussed advantageously, instead of postponing its presentation to a more advanced chapter on the general analysis of stresses. In discussing deflections of beams, Macaulay's method is given. On the Continent, it is usually called Saint Venant's method, since Saint Venant originated the special method of integration which reduces the deflection problem under various conditions of lateral loading to the determination of only two constants of integration. The last of these four chapters deals with more complicated problems of stress analysis, including a treatment of helical springs, beams on elastic foundations, crankshafts and an elementary theory of bending of plates. A very complete discussion of boundary conditions in the theory of plates is added to this chapter.

The next five chapters deal with the fundamentals of the theory of elasticity. The discussion begins with a general analysis of stress and strain which at once requires a more elaborate system of notations than was used in the earlier portion of the book. Beginners in theory of elasticity usually have difficulty with symbols, and would appreciate the use of a system of notation which can be applied both in elementary strength of materials and in the theory of elasticity. In a book attempting to bridge the gap between elementary strength of materials and the theory of elasticity, this unification of symbols seems doubly desirable. However, Prof. Southwell prefers to change his symbols at the beginning of the chapters on elasticity, and he adopts in these chapters the notations of Kirchhoff and Love. From the point of view of engineers and designers, it seems very desirable to have some unification of symbols used in the theory of elasticity, and perhaps it is time to do some work in this direction. However, Prof. Southwell is sceptical regarding the possibility of any international agreement in regard to symbols after so much has been written in this field.

In Chapters xi and xii, the general equations of the theory of elasticity are applied to such important problems as torsion and bending of prismatical bars (Saint Venant's problem), to two-dimensional problems, and to cases of axially symmetrical stress systems. The author gives not only the theoretical solutions of the problems, but discusses also various experimental methods of solution such as the soap film and photo-elastic methods, which in recent times have been developing so rapidly in connexion with technical applications of the theory of elasticity.

The last two chapters of the book deal with stability and vibration problems. Here it is shown how these problems can be advantageously handled by using Rayleigh's approximate method. At the end, Prof. Southwell raises the controversial question of priority connected with the Rayleigh-Ritz method. Without doubt, the fundamental idea of this method belongs to Rayleigh, but the part of Ritz should not be minimized, since he added much in its development. Rayleigh used the method only for an approximate calculation of frequency of the gravest mode of vibration of complicated systems, and was doubtful (see Rayleigh's papers in *Phil. Mag.*, **47**, 566; 1899: **22**, 225; 1911) regarding its application to the investigation of higher modes of vibration. Ritz generalized the method and made of it a powerful tool for solving problems of engineering and mathematical physics.

It is the belief of the reviewer that in this book, Prof. Southwell has made a very valuable contribution to the literature of the engineering sciences. It can be recommended both to students who wish to pursue advanced studies in the field of elasticity and also to engineers interested in application of the theory of elasticity to problems of machine and structural design. Throughout the book one finds a clear presentation of the subject given by a man who himself has contributed to its development. The book contains many interesting problems which give the student an opportunity to try his own skill and thus to improve his knowledge by exercise. S. TIMOSHENKO.

Insulin

Insulin:
its Production, Purification and Physiological Action. By Douglas W. Hill and Dr. Frederick O. Howitt. Pp. xi+219+4 plates. (London: Hutchinson's Scientific and Technical Publications, 1936.) 12*s.* 6*d.* net.

IN the fascinating history of the gradual unfolding—it is too early yet to say elucidation—of the function carried out by the pancreas by means of its internal secretion, insulin, one is above all impressed by the ingenuity of the physiological experiments, which, in the early days, at all events, rather overshadowed the chemical work.

When the authors of this monograph set themselves the task of sifting the evidence that has accumulated since the first preparation of insulin, it was indeed a difficult one. "Very little systematic work under well-defined and what may be called standard conditions has been recorded. Hence it is difficult to place a fair estimate on the value of the results from each set of experiments". They make this observation concerning the action of insulin, but, with some notable exceptions, the criticism is true of much of the work on this hormone. Among the exceptions, the authors might have given greater prominence to the outstanding work of Abel, Freudenberg, Scott and their collaborators.

The book attains a highly valuable object in that it is provocative of further research. Whether it be some important question of principle or theory, or some smaller point of observation of fact, it is certain that it must stimulate the seeker after truth to find the answer to many problems left unsolved. Time and again the authors show how contradictory are the results that have been published: one set of workers forming one conclusion, whilst the evidence of another group leads to the reverse. The reason for the diversities of opinion is nearly always to be found in one or both of two causes: either too little allowance has been made for animal variations (for example, one rabbit serving as control for another), or, effects ascribed to insulin have, in reality, been obtained with samples of such impurity that they would be more correctly described as protein mixtures containing some insulin. It is frequent in the literature to find no reference made either to the method of test or to the potency of the sample used, which makes it quite impossible to assess the value of conclusions.

Before the chapters on the chemical, physical and physiological properties of insulin, the authors wisely direct attention to the relative impurity of much of the material used, which, as they suggest, may yet furnish records of some value. It is difficult to see, however, how any value could be attached to observations on the solubility of 'insulin' of potency 40 units/gm., that is, containing 99·8 per cent of impurity. Even in 1923, when these observations were published, much purer material was available.

Of particular interest is the chapter that deals with the effect of the other hormones upon insulin action, and it is a tribute to the authors that one should be led to speculate beyond the subject that they set themselves to treat, stimulated to inquire further into the question of endocrine balance.

The section on standardisation calls for some criticism. The emphasis laid on such questions as the distribution of sugar between plasma and corpuscles, which has little bearing on standardisation, in which whole blood is always laked, is an extravagant use of valuable space when some interesting aspects of testing could not even be touched on. In a work of which the stated object is to sift the evidence, it is surprising to find quoted an observation made in 1923 to the effect that at least three rabbits should be used for a test, whilst no mention is made that for years now about five tests on twenty rabbits each would be considered a reasonable number for an accurate assay. The suggestion of the greater regularity of behaviour of mice is not in accord with the general consensus of opinion to-day. The observation of Marks, that the mouse test gives results 15–30 per cent higher than the rabbit test, was made with crystalline or highly active amorphous insulin using a standard of much lower activity: it has been shown that the discrepancy may be in the opposite direction when relatively inactive substances are assayed.

The book is attractively presented, and the subject matter most clearly arranged. Above all, the bibliographies at the end of every chapter will be of inestimable value.

K. C. L.

A Book of Fishes

Naturgeschichte und wirtschaftliche Bedeutung der Seefische Nordeuropas

Von Prof. Dr. Ernst Ehrenbaum. (Sonderausgabe aus dem Handbuch der Seefischerei Nordeuropas, Band 2.) Pp. x+337+26 plates. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1936.) 44 gold marks.

DR. ERNST EHRENBAUM, formerly of Heligoland, afterwards director of the Fisheries Institute in Hamburg, has been for many years one of the best known and most trusted of all the many naturalists engaged in fishery investigation. Dr. H. Lübbert, once better known as Captain Lübbert, is a rare blend of seaman and scientific man; he has had more to do than any other man with the development of the German sea-fisheries, and he has been called in to advise Governments in many parts of the world. Thirty years ago, Captain Lübbert founded *Die Fischerbote*, one of the very best of all fishery journals; and for most of the time since then the two have edited it together. Now they have embarked on the great enterprise of publishing a "Handbuch der Seefischerei", of which a good many parts are now ready, and which will form at last an encyclopædia of all our northern fisheries—from the Murman Coast to Brittany, from oysters to whales. Nearly two hundred years ago Duhamel du Monceau did much the same thing, and did it wonderfully well; another hundred years and we come to Isaac Walton and Cotton's "Universal Angler"—little, but good; yet another fifteen hundred years and we make the best we can of Oppian.

The first volume of the great "Handbook" contains, or will contain, a sketch of oceanography, a description of the sea-bottom, an account of marine vegetation, a discussion of the diet and ultimate sources of nutrition of marine animals, and in general of the balance of Nature in the sea. The book before us is the second volume, and deals systematically with the fish of our northern seas; it gives a full but very concise account, in some 300 closely printed and richly illustrated pages, of all our marine fishes; and not only the salmon but also most of our fresh-water fishes come into the story also, as inhabitants of the Baltic Sea. Almost every fish has its figure, except a very few which are obviously not needed here: such as some of the rarer deep-sea *Macruri*, or some of the Mediterranean and Atlantic fishes, *Box*, *Sparus*, *Pagellus* and the like, which only come to our northern seas as errant stragglers. Few of the figures are original; they are mostly drawn, and admirably reproduced, from Smitt, Collett, Joubin, Day, and occasionally Cuvier.

This is a book not only about fish but also about fisheries; for ours is a commercial age, and we want to know the fish in the market as well as the fish in the sea. Day's "British Fishes", written fifty years ago, and for most purposes our standby still, is an excellent book, full of information and knowledge. But the fisheries of the world have changed mightily in the half-century from Day to Ehrenbaum. When Day wrote, the saithe (for example) was caught "by angling, or line-fishing, the lugworm being found a good bait"; it was "not much sought after, being held in little esteem". But now, as Ehrenbaum tells us, 100,000 tons (114 million kilos) were brought to market in 1932 from our northern seas, all the way from the North Sea to Iceland and Spitsbergen. Fifty years ago, the megrim was a rare fish, to be recorded one by one; to-day at least 6,000 tons come to market every year, and it fetches a good price, in Germany even a high one.

The catch and the value of each and all of the marketable fishes are dealt with briefly but adequately in this book, but so indeed is every other part of the subject; Dr. Ehrenbaum omits little, and forgets nothing. The few pages on the cod tell how G. O. Sars studied its development, how Michael Graham and others have studied its rate of growth, what Hjort has written on its migrations, how Einar Lea has studied its scales. An excellent account of the mackerel tells of its migrations between the deep sea and the coastal waters, how its diet changes with place and season, and how it fasts about Christmas or New Year; how we catch it, on one hand by line and on the other by the trawl; and how, unlike the salmon or the sprat, it seems to spawn at one and the same time, whether off the Irish coast or at Heligoland. The part on the tunnies, tunny, bonito, germon, pelamyd, albacore and so on, in all their puzzling and shifting nomenclature, is particularly good. There is an up-to-date account, based mostly on R. S. Clark's work, of the many northern skates or rays and their eggs; Holt's work on the gobies, Tate

Regan's amazing account of the males of *Ceratias*, the work of C. J. G. Petersen and many others on the varying rate of growth of plaice according to the density of population and the available food, and of course Johannes Schmidt's epoch-making studies of the eel—all these are among the many matters clearly and lucidly explained.

In short, this is a good book and a useful one all through. It is not for easy reading but for reference and study; and few will open it without finding what they want to know. D. W. T.

The New Agriculture and World Peace

Nations can live at Home

By Dr. O. W. Willcox. Pp. 279. (London: George Allen and Unwin, Ltd., 1935.) 10*s*. net.

PEACE is the paramount need of the world to-day. Of the many factors, complex, obscure and profound, which tend to endanger peace and produce war, one at least can be definitely diagnosed as the increasing pressure of population, in some parts of the world, on land resources. Any practical means that can be applied to reduce that pressure should, if coupled with the requisite social and political adjustments, become a powerful agent of world peace. Such is the message of this book, a message of profound and vital importance, of particular interest to scientific agriculturists and students of population problems, but also of wide general appeal. Many nations are at present quite unable to obtain from their own soil all their requirements in food and raw material, which they must import accordingly and pay for by exports. But with the vast shrinkage in international trade and the increasing difficulties of keen and world-wide competition, this method of obtaining the desired supplies may appear, to some of the nations so situated, as much more difficult and less satisfactory than that of actual, and if need be aggressively, warlike attempts to find additional territory outside their own boundaries. Dr. Willcox, however, now offers to the peoples in these straitened and parlous circumstances a simpler, easier and much more effective method: that of greatly increasing the yields of their own soil, by using to their fullest extent the wonderful powers of crop productiveness that modern plant-breeding and soil science —the new agriculture or agrobiology—has placed within their reach.

The book makes a powerful and compelling twofold appeal: first, because of the inherent interest of the wonderful results claimed on behalf of agrobiology in respect to vastly increased yields from the land; and secondly, the profound economic, social and political consequences of such agrobiological advance.

Whilst fully admitting, however, that plant-breeding or genetics and soil science have made immense strides and produced results of the kind and magnitude herein described, backed up indeed by large-scale field work in many parts of the world, it nevertheless seems to the present reviewer that the difficulties due to such things as plant pests, drought, flood and other meteorological disturbance, the human element, and above all costs, have just possibly been brushed aside a little too indifferently.

It was perhaps scarcely possible, within a book of this compass, to deal fully with all the practical difficulties in technique. The far greater difficulty is that of getting the new methods generally adopted by those very conservative and sceptical people, the farmers. In the very interesting chapter dealing with the special conditions in various 'deficit' or 'beyond the threshold' countries —Great Britain, Germany, Italy, Japan—Dr. Willcox describes the remarkable results obtained by the Better Farming Association in Japan, in the matter of rice yields. The best type of farmer, using the best and most productive variety of rice plant, under the best agrobiologic conditions, obtained yields several hundred per cent above the average. But it was very difficult, if not impossible, to arouse the interest of the majority of farmers in Japan.

There is, of course, the further complication of over-production in those parts of the world which are mainly agricultural, and supply world markets. This is touched upon in the present book, and provided for plausibly if not too convincingly.

Some of the figures given for crop yields or possibilities are startling enough, especially when combined with reduced crop cycles so that several crops can be taken from the unit of land each year. These are studied at some length in relation to population density, and the relative values of different crops from the protein–carbohydrate ratio point of view. It is generally concluded that population densities up to 15,000 or more per square mile are not beyond the bounds of agrobiological possibility; but it is scarcely fair to the author to state these bald figures without the accompanying well-reasoned arguments in support.

W. G. L. C.

Libraries for Scientific Research in Europe and America

By H. Philip Spratt. Pp. 227. (London: Grafton and Co., 1936.) 10*s*. 6*d*. net.

THIS informative little book is the result of a series of tours made by the author in Europe and North America, and sets out to describe the research facilities existing in the more important specialist libraries of the two continents—not only from the point of view of the librarian who wants to know the latest methods in actual use, but also from that of the research worker anxious to learn in what way modern libraries administer to his needs in the search for published information on his subject.

After describing six representative libraries in London, the author takes us *via* Paris and Brussels to Scandinavia, Germany, Poland, and Russia—finding in the latter country that most of the libraries are dominated by "books on science (and communism)"—and thence to America, to which about one half of the book is devoted. In the case of each library—and nearly a hundred are included in the book—Mr. Spratt gives details of the arrangement of catalogues and indexes, of the classification used (with a distinct leaning towards the Universal Decimal Classification), of information services and the provision of photographic and other apparatus, and of the general administration in so far as this interests the public as users.

The survey is thorough and there is evidence throughout of the author's practical knowledge of the problems involved and of his first-hand inquiry into the present methods of dealing with them. The index is well constructed but lacks balance. The entry "British Museum, 47" supplies the information that the Bibliothèque Nationale ranks with the British Museum, while "John Crerar Library, 186" refers the reader to a five-page description of that institution.

A. G.

Primitive Law

By A. S. Diamond. Pp. x+451. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 25*s*. net.

MR. DIAMOND holds that Sir Henry Maine's conception of primitive law as inseparable from the concepts of primitive religion and morality is no longer tenable in the light of modern research, and, further, that in the development of early law there is a parallelism which corresponds with economic and social progress. Thus the code of Hammurabi, for example, is formulated in a society which corresponds in economic development with the societies which produced the codes of medieval Europe. The undoubted religious elements which appear in the codes as they have come down to us are due, he holds, not to the fact that they embody survivals from an earlier stage in which religious belief, law and morality were undifferentiated, but are due to introductions by priestly scribes at a date later than the formulation of the codes.

Mr. Diamond has made a careful analysis of such early codes as have survived, and has surveyed in detail the practice of modern primitive peoples for evidence in support of his view. This vast mass of fact brings out clearly certain weaknesses in the over-simplification inherent in Maine's point of view and method. On the other hand, as regards Mr. Diamond's principal contention, however much may be conceded to priestly intervention, the distinction by which the author would seek to rule out Maine's view is largely a question of definition and determination of the point at which what he regards as law begins.

The Extra Pharmacopœia of Martindale and Westcott

(Published by direction of the Council of the Pharmaceutical Society of Great Britain.) Twentieth edition. Vol. 2. Pp. xxxvi+889. (London: The Pharmaceutical Press; H. K. Lewis and Co., Ltd., 1935.) 22*s*. 6*d*. net.

W. H. MARTINDALE, who had for many years carried on his father's work as author of the "Extra Pharmacopœia", died in 1933. He had brought out a new edition every four years and the book has become indispensable. He produced the first volume of the twentieth edition in 1932. The second volume has now been prepared by a committee of the Pharmaceutical Society—under the editorship of Mr. C. E. Corfield, the editor of the "British Pharmaceutical Codex". This committee has undertaken the heavy task of preparing future editions. It has always been a source of wonder that Dr. Martindale should be able to do all this by himself; Dr. Westcott's collaboration only lasted for a period.

The first volume deals with the manufacture, composition and uses of drugs. The second volume consists of a series of appendixes dealing with diverse subjects such as the analysis of bread and butter, health resorts, disinfectants and proprietary medicines. The committee has managed to carry out a thorough revision without destroying the book's individuality. Most of the familiar sections are still there, expanded slightly and brought up to date. The section on modern views of atomic structure now occupies six pages. Modern methods of biological assay have been included, and there is much interesting information about recent work on hormones and vitamins.

Mechanics and Hydrostatics

By Dr. R. G. Mitton. (Dent's Modern Science Series.) Pp. ix+275. (London: J. M. Dent and Sons, Ltd., 1936.) 3*s*.

THIS volume has been designed to cover the School Certificate and Matriculation courses in mechanics and hydrostatics. The author has presented the subject matter in a very lucid and interesting manner, and a noteworthy feature is the number of excellent photographic reproductions illustrating the practical applications in industry of the principles discussed. It will also be encouraging to up-to-date teachers to find that the author has adopted the policy of treating absolute units as fundamental from the earliest stages.

The book is amply supplied with exercises, many of which have been taken from the various School Certificate and Matriculation examination papers. Answers to these are also given.

Seasonal Changes in the Underwaters of Bermuda

By Prof. Walter Garstang

AFTER a visit last year to the Bermuda Biological Station, I directed attention in a semi-popular article to the unique opportunities at this lonely Atlantic island for oceanographic research, and suggested that continuous local investigation of the deep water around the island would be likely to hasten a solution of the "Atlantic Water" problem, which has such important bearings on European fishery and other questions (*Discovery*, December 1935). This opinion has been considerably strengthened by the subsequent study of various hydrographic reports, and especially by a collation of the published data recorded by various research vessels in the immediate neighbourhood of the island.

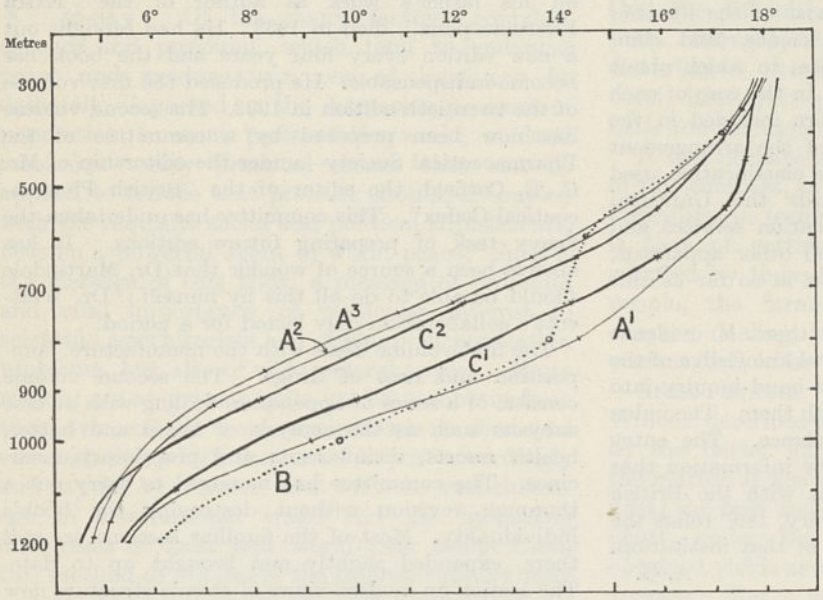

FIG. 1. Temperature curves of selected Bermuda stations (intermediate layer only).
A^1, A^2, A^3: *Atlantis*, February, April and December 1932, respectively.
B: *Bache*, February 1914.
C^1, C^2: *Challenger*, April and May 1873, respectively.

Temperature and salinity determinations at the following stations have been used: H.M.S. *Challenger* (temperatures only), stations 37 (April 24, 1873) and 57 (May 30, 1873); st. 10179 of the U.S. Fish Commission's vessel *Bache* (Feb. 18, 1914); st. 1339 of the Danish *Dana* Expedition (May 10, 1922); and six stations of the Woods Hole Oceanographic Institution's vessel *Atlantis*, namely, 1125 (Dec. 5, 1931), 1145 (Feb. 17, 1932), 1220 (April 17, 1932), 1359 (Aug. 27, 1932), 1431 (Dec. 5, 1932), and 1464 (Feb. 12, 1933). These stations are dotted about the island in various directions, all within a radius of sixty miles, except the first *Atlantis* station (1125), which lay 120 miles to the north-west. The data for this station furnish one of the extremes in the range of variation, but its inclusion seems to be amply warranted by a comparison with other stations at the same period.

The general characteristics of the water-column in the Sargasso Sea are well-known, and many temperature curves from the region have been figured by the *Challenger*, *Dana* and other expeditions. All show beneath the variable surface region two more or less vertical portions, representing relatively uniform layers: (*a*) a sub-surface layer of high salinity (*c.* 36·5 per mille) below the influence of solar radiation (150–400 metres), but preserving the effects of winter convection at a nearly constant temperature of 17°–18° (the average surface minimum), and (*b*) the deep waters (below 1,000 metres) of low salinity (less than 35·0 per mille) and temperature less than 5°. Between these two strata lies an intermediate layer (*c.* 400–1,000 metres) the variations in which are the main subject of this communication. It ranges over a considerable series of closely stratified temperatures and salinities, which confer a characteristic slope upon this portion of the curve. When the curves of the various Bermuda stations are superimposed upon the same large sheet of graph paper, it can be seen that the slope representing the intermediate layer changes its position with the season of the year, running at a higher level and to the left (that is, nearer the surface and through lower temperatures) during the summer and autumn, and lower down to the right (that is, through higher temperatures) during the winter and early spring—the very opposite of seasonal changes at the surface. Temperature and salinity curves follow the same orderly cycle, which, so far as the records go, differs only in amplitude from one year to another

(Fig. 1). The *Bache* curve for February is unique in showing autumn conditions above and winter conditions below. The soundings must have been taken while the winter change was in progress.

In the available space only a few of the curves can be conveniently reproduced, but the regularity of the sequence and the varying amplitude of the annual change come out almost equally well if we take a few representative isotherms and isohalines from the curves, and plot their levels in the water-column at the various times of the year represented. The invaluable *Atlantis* data naturally furnish the basis of such a diagram (Fig. 2). The continuous lines represent the varying depth of the isotherms 17°, 15°, 11·5°, 8° and 6° and between the first four of these the isohalines 36·2, 35·6 and 35·2 per mille run as lines of dots and dashes. The *Challenger* records in 1873 for April (C^1) and May (C^2) have been connected with those of the first *Atlantis* February, the *Dana's* for May 1922 with the *Atlantis* April, and the *Bache's* for February 1914 with the second *Atlantis* December—of course, merely for convenience of reading.

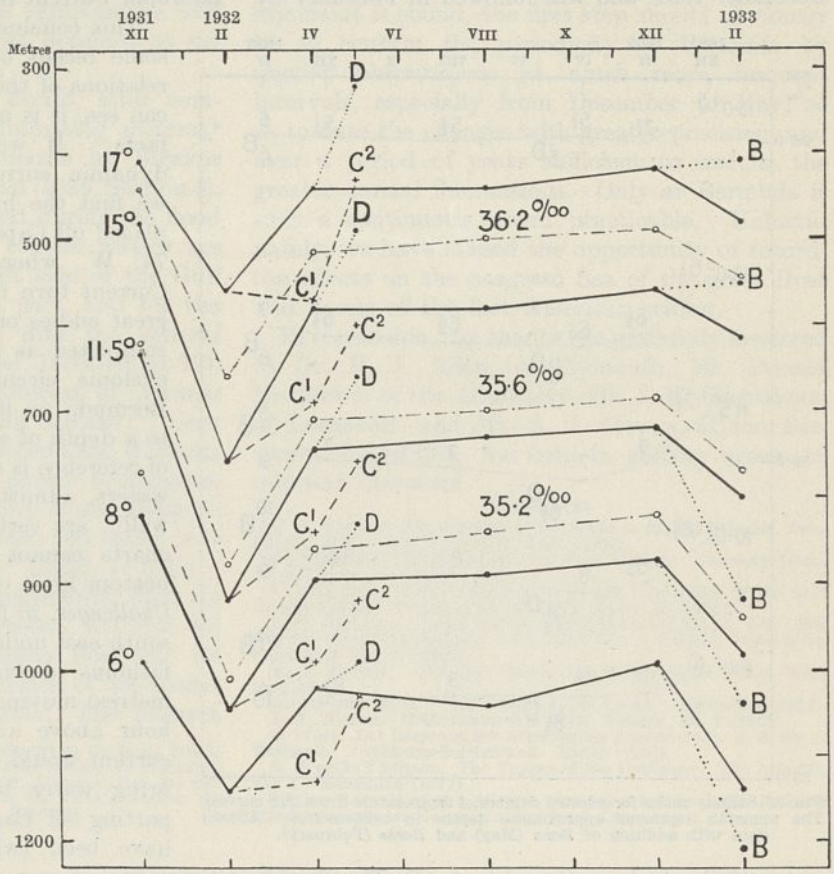

FIG. 2. Depth of selected isotherms and isohalines from the complete curves, showing monthly changes.
●—, *Atlantis* isotherms.
○—·—, *Atlantis* isohalines.
×— —, *Challenger* isotherms (C^1, April; C^2, May 1873).
● . . . , *Dana* (*D*) and *Bache* (*B*) isotherms.

It is plain from the figure that the active parts of the annual cycle are concentrated in the period from December to April or May. In February there is a sharp drop in the level of the isotherms (and isohalines) by some 100–300 metres, and in April (or April and May) a corresponding, but not necessarily an equivalent, rise. It should be borne in mind that, owing to the normal graduation of temperature and salinity from above downwards, the lowering of an isotherm implies a deepening of the mass of warmer water above it, and the lowering of a whole series of isotherms a general increase of temperature throughout the water-column represented. Similarly, a raising of the isotherms implies an upward extension of the colder waters and a corresponding decrease of temperature at the depths under consideration; so also with isohalines and salinity, *mutatis mutandis*. From April to December, the *Atlantis* isotherms and isohalines show little or no changes of level, though there is a slight upward tendency, especially of the isohalines. It may therefore be inferred that the relatively low levels of the *Challenger* isotherms in May 1873 and the high levels of the *Dana* isotherms in May 1922 were probably maintained throughout the summer of their respective years, implying relatively high temperatures throughout the intermediate layer in the summer of 1873, and low temperatures in 1922. The conditions in 1932 were intermediate, but nearer those of 1873 than of 1922, though attained earlier, in April instead of May. Confirmation of the exceptional warmth of the intermediate waters throughout the Sargasso Sea in the summer of 1873 has in fact already been given by Helland Hansen when comparing the *Challenger* station 65 (halfway between Bermuda and the Azores) with corresponding stations of the *Michael Sars* in June 1910 (Murray and Hjort, 1912, Fig. 210).

So far, I have described this sequence in terms of obvious changes in the level of isotherms and isohalines, which, as oceanographers know, are

liable to disturbance from a variety of causes. Although some of these factors could at once be eliminated from the present case, it is sufficient here to note that the Bermuda cycle is not conditioned simply by a periodic undulation of the isotherms, but by measurable changes in the temperature-salinity ratio. Fig. 3 shows the salient differences in the salinity associated with various degrees of temperature at the Bermuda stations regardless of depth. The ratio of salinity to temperature attained a maximum height in December 1931, and was followed in February by

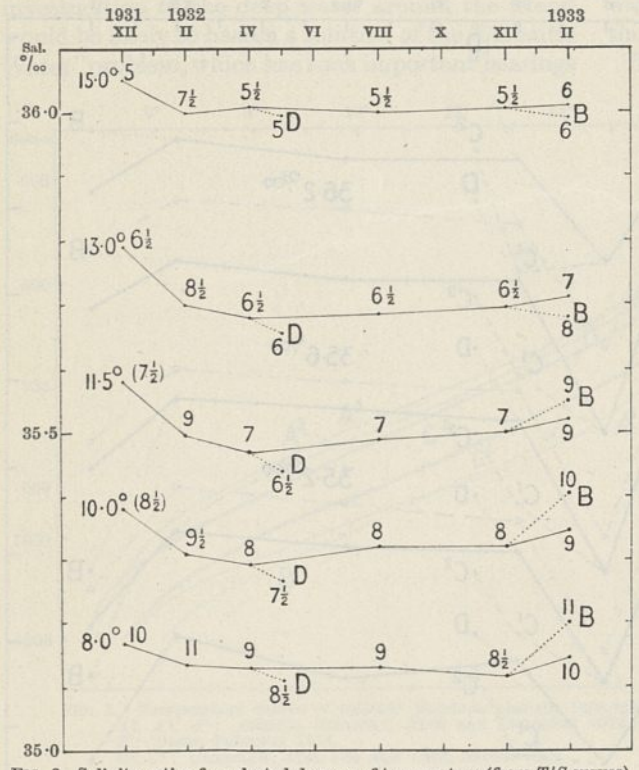

FIG. 3. Salinity ratios for selected degrees of temperature (from *T/S* curves). The numerals represent approximate depths in hektometres. *Atlantis* data with addition of *Dana* (May) and *Bache* (February).

a smart fall, which continued to April. The *Dana's* records for May 1922 show the minimum for the whole series, thus pointing to the probability that a fall in the salinity ratio is a regular phenomenon from February until April or May. After April 1932, the ratio rose slightly through the summer and autumn to December, when it was succeeded by a marked rise in the following February, greater for the lower degrees of temperature than the higher.

The apparent inference to be drawn from these changes is that occasionally in February (1932), and regularly in April or May, there takes place a general infiltration of alien water of less than normal salinity, the influx of which declines during the summer and autumn and is usually cut off more or less completely in February (1914, 1933). This cycle is, of course, precisely that of ice-bound coastal waters, locked up by frost in winter, and released in full flood in spring. The only possible source of such water in the present case is the coastal tract of mixed waters on the north side of the Gulf Stream, mainly derived, according to Bigelow, from the Gulf of St. Lawrence by the Cabot Strait, but mixed undoubtedly with Gulf Stream overflows and the coastal waters of the Gulf of Maine, probably also in severely 'Arctic' years like 1929 with contributions from the Labrador Current itself.

This conclusion may seem to conflict with some recent opinions as to the nature and relations of the Gulf Stream, but, so far as I can see, it is not opposed by any established facts. If we turn to Jacobsen's hydrodynamic current-charts (1929, figs. 53–56) we find the hub of the Atlantic circulation placed off Cape Hatteras in lat. 36° N., long. 74° W., where Gulf Stream and Antillean Current turn markedly east and give rise to great eddies on the right, some of which are completed as inner, middle and outer anticyclonic circuits, the middle one bathing Bermuda on its way to the Windward Isles to a depth of some 500 metres. As the depth of reference is only 1,000 metres and the deep waters, admittedly recruited from the "cold wall", are certainly moving in spring, these charts cannot be regarded as defining the bottom limit of the currents indicated. The *Challenger*, in fact, at st. 37 in April found a south-east undercurrent at Bermuda from 200 fathoms down to 400 fathoms (350–750 metres) moving at a rate of about ¼ mile per hour above and 1/10 mile below. Such a current would require at least two months to bring water to Bermuda from the water-parting off Cape Hatteras, but it may well have been twice or three times as strong during the climax of the May flood.

It is also noteworthy that exactly abreast of Jacobsen's water-parting (vortex ?), but on the landward side of the Gulf Stream, lay the *Bache* station 158 and the *Dana* station 1349 (the former in lat. 36° 12′, long. 74° 25′, the latter in lat. 36° 16′, long. 74° 33′), which presumably reveal the relations of the coastal waters to the Gulf Stream in February and May respectively. In February, Bigelow found an isolated 'tongue' of water of temperature 11°–12° and salinity less than 35·2 per mille dipping down from the surface like a 'waterfall' over the edge of the continental shelf to a depth of some 300 metres, and separated from the Gulf Stream by a nearly vertical wall of water 500 metres deep, of 35·5–36·0 per mille salinity. In May the *Dana* found this wall, from

200 metres downwards, bent outwards as an inclined plane, beneath which the mass of coastal water, *colder and less saline throughout than in February* 1914, was completely continuous (except the most superficial stratum less than 35·0 per mille) with the intermediate layers of the Gulf Stream column. At 300 metres the temperature and salinity at the *Bache* station were 11·4° and 35·19 per mille; at the *Dana* station in May they were down to 8·17° and 35·08 per mille. At the *Dana* station 1351, in the Gulf Stream itself, water with approximately this temperature and salinity lay 600 metres deep. At Bermuda at the same time it lay at 900 metres.

There can indeed be little doubt, after comparing these facts and the illuminating sections* provided in their respective reports by Bigelow (1915, figs. 11, 12, and 49), Nielsen (1925, Section 4), and Jacobsen (1929, fig. 11), that during the flood period in spring the pent-up coastal waters are incessantly mixing with the left side of the Gulf Stream, to pass through it in part, and for the rest to be swirled eastwards into the general circulation of the Sargasso Sea (cf. Jacobsen, p. 19). Iselin also, in a preliminary forecast of *Atlantis* results, has remarked of the Gulf Stream: "Very little of the Gulf water remains when Cape Hatteras is reached. The current is of course continuous, but gradually the Gulf of Mexico water becomes replaced at all depths by Sargasso Sea water *or a mixture of this and Slope Water*" (1933, p. 231).

Altogether, in spite of the fragmentary data on which it necessarily rests at present, the case for a seasonal cycle in the Sargasso Sea and its dependence on the periodic release of ice-bound coastal water seems unmistakable. The interest of the relation is practical as well as theoretical, for it opens up at once the prospect of our ability to attack the 'Atlantic Water' problem from a new and much more promising angle. The periodic incorporation into the intermediate layer of the Sargasso Sea of millions of tons of alien water must result in a periodic eastward spreading of the whole water mass. Annual variations in the amplitude of the extension may well be concerned in determining the irregularities of Atlantic incursions upon the coasts of Europe. If this argument is sound, the first step should obviously be to confirm the periodicity at Bermuda by regular observations at much more frequent intervals, especially from December to May, so as to date the changes with greater precision, and over a period of years sufficient to include the greater annual fluctuations. Only at Bermuda is such a continuous record practicable. Unfortunately, we have missed the opportunity of recording the effects on the Sargasso Sea of the great frost and floods of the last American winter.

In conclusion, my thanks are gratefully tendered to Dr. E. J. Allen, of Plymouth, Mr. Donald Matthews, of the Admiralty, Dr. J. N. Carruthers, of Lowestoft, and Mr. A. J. Clowes, of the *Discovery* Expedition, for help in getting access to relevant literature.

* A temperature section from *Atlantis* data given by Iselin (1933, fig. 2) for the same region in February cannot readily be compared owing to lack of isohalines. It is noteworthy, however, that the isotherms are shown appreciably lower than in the *Dana's* sections for May, though with less difference than at Bermuda.

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The 'Specific Action' of Ultra-short Wireless Waves

By Prof. W. E. Curtis, F.R.S., Dr. F. Dickens, and S. F. Evans

DURING the last ten years or so many investigations have been made concerning the biological and medical effects of short wave radiation. The absorption of such radiation by tissues necessarily results in the liberation of heat, and many of the effects observed are admittedly due to this cause. They could alternatively be produced by other methods of heating, although the radiation method frequently offers special advantages and potentialities. It is being pursued energetically in various laboratories and clinics, and appears to rest on a sound theoretical and experimental basis[1].

The literature of the subject, however, contains frequent references to other effects, usually termed 'specific', in the sense that they can only be produced by the short-wave method, that is to say, that they are not primarily thermal in origin. In some cases also it is claimed that the effects are restricted to certain wave-lengths, or that an optimum wave-length exists. So far as is known at present, from physical and chemical evidence,

radiation of these wave-lengths (3–15 metres) is not directly convertible into atomic or molecular energy, and such observations, if substantiated, would be of great interest and importance. We have therefore thought it desirable to scrutinise the evidence rather carefully, tracing the various references to their sources, and attempting, where possible, to repeat the experiments in question.

The effects claimed are diverse in character, including metabolic changes in tissues, physical changes in liquids and colloids, decolorisation of dyestuffs, bactericidal action and so forth. The one feature common to them all, we find, is the absence of any incontrovertible proof of their existence, and this in spite of their unquestioned acceptance by numerous authors of reviews and research publications. The details which follow should serve to expose the very unsatisfactory situation which exists at present, and perhaps to stimulate further investigation of the alleged phenomena.

(1) As an instance of effects which are probably due to the inadequacy of the precautions against heating, we may take the results of Reiter[2], who claimed to have established the existence of an immediate destructive action on the metabolism of malignant tissue when exposed to radiation of wave-length 3·4 metres. In attempting to repeat these observations*, we found that to maintain approximate constancy of temperature it was necessary to take much more drastic measures than Reiter appears to have done. For example, in order to keep the tissue contained in a suitable vessel, at 40° C., it had to be immersed in a bath containing liquid paraffin at 6° C. Under these conditions, no effect on metabolism was observed[3] when the specimen was subjected to intense irradiation on a wave-length of 3·4 m.

(2) The importance of surface tension effects has been stressed by Schliephake and Compère[4], who claim to have observed a lowering of surface tension in certain colloidal solutions including blood and serum. They consider that although earlier observations might conceivably be explicable as heat actions, "it is already permissible to say that we have now obtained for the first time certain proof of the existence of an effect of ultra-short waves that cannot be explained by the action of heat alone". The experiments referred to were made by allowing serum and other liquids to run from a stalagmometer placed between the electrodes of a 6-metre transmitter, surface tension being measured in the usual way by counting the number of drops for a given volume. It is stated without supporting data that "even a rise of temperature of several degrees had no influence whatever on the drop formation", and also that any possibility of a heat effect was rigorously excluded by comparative experiments in which the drops were warmed by radiant heat. No details of field strength or of the concentrations of the reagents used are given, although Schliephake in his book[5] (p. 52) states that definite dilutions are necessary. We have attempted to repeat this work, but without success. The stalagmometric method of measurement of surface tension was found to be entirely unsuitable for this purpose, since the heating effect was very great and the temperature of the drops could not be measured with precision. Using the more accurate and convenient torsion balance method, which further allows the determination of the temperature of the mass of liquid, we were unable to find any effect whatever on the surface tension of serum, although an effect of the magnitude reported by Schliephake would have been readily detected. The field used was of such strength that in stalagmometer experiments the drops of serum were heated through about 5° C. in 10 seconds. The variation of surface tension in the short wave field has been referred to in the literature as the "Schliephake Effect" but, in our opinion, proof of its existence is entirely lacking.

(3) Some further examples of specific action are given by Schliephake in his book. Working with Recknagel, he claims to have observed changes in the viscosity and stability of colloids which are opposite to those caused by rise of temperature. Only sixteen lines of description of these fundamental phenomena are given, and in reply to a request for fuller information it was learned that this could not be given "on personal grounds".

(4) Of particular therapeutic interest are the claims put forward in respect of bacteriological effects. Haase and Schliephake[7] claim that they have demonstrated killing of staphylococci and tubercle bacilli by exposure at body temperature to short wave radiation; Recknagel and Schliephake[6] report a marked reduction of the activity of diphtheria antitoxin following similar treatment, and attention is directed to the confirmatory work done by Szymanowski and Hicks[8]. In a paper[9] published six months later, however, Szymanowski and Hicks withdraw their earlier results on toxin and also report that, repeating the work of Schliephake and Haase on staphylococci, they were unable to establish any effect of the high-frequency field. They conclude that "the consistently negative results reported in this paper lend further evidence to the belief that the only direct therapeutic action of ultra-high frequency radiation is related to the problems of conductivity in tissues and consists in an elevation of temperature". In his book Schliephake does not refer to the latter paper.

* On behalf of the British Empire Cancer Campaign.

(5) A book on "The Foundations of Short-Wave Therapy" by Holzer and Weissenberg[10] has recently appeared. These authors are vague in their references to 'specific actions', but refer to colour reactions, notably decolorisation of the dye pinacyanol in a short-wave field[11]. As this appeared to be a simple and striking example of the effect of short waves, we attempted to repeat it in our laboratory, but without success, and we are informed in a personal communication from Dr. Holzer that he has since been unable to reproduce the effect.

(6) Another similar example which we unsuccessfully attempted to verify is Esau's observation, quoted by Pflomm[12], that turpentine oil could be hardened by exposure to a short-wave field; no details were available, and although we have asked Prof. Esau for fuller information we have as yet received no reply. Still more mysterious are the effects on operators of short wave appliances reported by both Holzer and Schliephake. The precise nature of these effects appears somewhat indefinite, but their principal manifestations are psychological and can be prevented by suitably screening the apparatus. The present writers, working on 3 metres with totally unscreened apparatus using a power much greater than that quoted by Schliephake, have failed to notice any effects following daily exposure, and they have been informed by research engineers working with very high power on ultra-short wave-lengths that such effects are unknown in their experience.

(7) One of the most promising lines of attack would appear to be the investigation of anomalies in dielectric constants at these frequencies, with a view to possible correlation with dipole moment phenomena. Hausser[13] has published work in which such effects were observed for sphingomyelin at a frequency corresponding to a wave-length of 5 metres. This example, if confirmed, would constitute the nearest approach to the clear demonstration of a specific effect yet made; it is therefore of particular interest, though it appears from personal communication with the author that the position is not yet cleared up to her entire satisfaction. In any case its relationship, if any, to the spectacular effects claimed by the more enthusiastic protagonists of specific short-wave actions is still obscure.

We believe that, with the exception of the last example, the above selection of experiments and observations is typical of those upon which the hypothesis of a specific action has been built. If such an effect exists, it should be possible for the discoverers to describe at least one clear-cut experiment which could be repeated by other workers. In the absence of such evidence we consider that the great mass of inconclusive observations which has been presented is a very insecure foundation for the rapidly growing belief in specific short-wave therapy. Whilst the possible existence of specific actions of ultra-short waves cannot be denied, in our opinion such effects have not as yet been adequately demonstrated. We therefore find ourselves in agreement with the conclusions of a recent report to the Council on Physical Therapy of the American Medical Association, by Mortimer and Osborne[14]:

"There is no conclusive evidence from the literature nor were we able to substantiate the claim of specific biologic action of high frequency currents (short-wave diathermy). In our opinion the burden of proof still lies on those who claim any biologic action of these currents other than heat."

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Obituary

Prof. W. E. Dalby, F.R.S.

PROF. WILLIAM ERNEST DALBY, emeritus professor of engineering in the University of London, who died at his home at Ealing on June 25 at the age of seventy-two years, received his practical training in engineering in the Stratford locomotive works of the Great Eastern Railway, and afterwards at the L. and N.W.R. works at Crewe. His duties at Crewe afforded him exceptional facilities for gaining experience in all branches of engineering work, and in construction and maintenance of both permanent way and locomotive. In 1894 he was at the University of Cambridge as assistant to the late Sir Alfred Ewing, who was then developing a Department of Engineering in that University. He left Cambridge to become professor of mechanical engineering and applied mathematics at the Finsbury Technical College, and in 1904 he succeeded the late Prof. W. C. Unwin as University professor of engineering at the Central Technical College, South Kensington. When that College was incorporated in the Imperial College of Science and Technology as the City and

Guilds (Engineering) College in 1907, he was made a member of its governing body and remained so until his retirement from the professorship in 1931. He was Dean of the City and Guilds College from 1906 until his retirement, and at the jubilee celebrations of the College in 1934 he was elected honorary fellow of the City and Guilds of London Institute.

Prof. Dalby served as dean of the Faculty of Engineering in the University of London for four years and as senator for eight years. He was elected a fellow of the Royal Society in 1913, was for some years vice-president of the Institution of Mechanical Engineers, and at the time of his death was a vice-president of the Institution of Civil Engineers. The Institution of Naval Architects also elected him honorary vice-president. He was president of Section G (Engineering) of the British Association in 1910, and was a member of some of that Association's research committees, notably the Gaseous Explosions Committee. During the Great War, Prof. Dalby served on several Government committees, and carried out much confidential research work for all three of the fighting Services. Of the many committees on which he served during the War and afterwards, mention may be made of the Board of Invention and Research, the Engineering Section of the War Committee of the Royal Society, for which he acted as secretary, and the Bridge Stress Committee.

It was only natural that Prof. Dalby's close connexion with railway problems during his service at the locomotive works should direct his attention to the many mechanical problems that arise in steam engine practice, and in the earlier part of his professional career his interest was largely centred on such problems. Towards the end of the nineteenth century, the demand for increased speed of engines brought into prominence the closer study of the methods of balancing rotating and reciprocating masses of engines. Prof. Dalby devoted considerable attention to this problem, and at the spring meeting of the Institution of Naval Architects in 1898 he described a new method which he had devised of solving balancing problems. The advantage of his method was that, by using a 'reference plane', the problem was reduced to one of graphical vector addition. This method he developed in his book "Balancing of Engines", which was first published in 1902. It has received such wide acceptance and has been so generally adopted that its authorship is in danger of being forgotten. In the latest edition of this work (1929) the author rightly states in the preface that his method "has found its way into textbooks with *and without* acknowledgment". Designers of high-speed engines are indebted to Prof. Dalby for so clear and simple a method of solving their balancing problems, and these problems are also not without interest for civil engineers, as the Report of the Bridge Stress Committee conclusively shows. In 1906 he published his second book on engine mechanism, namely, "Valves and Valve Gear Mechanism".

In connexion with the British Association's Gaseous Explosions Committee, Prof. Dalby was associated with the late Prof. H. L. Callendar in attempts to measure directly the temperatures inside the cylinders of gas engines. The method they employed required accurate indicating of the engine, and as the optical indicators then available were not sufficiently accurate for their purpose, Prof. Dalby improved on the design and produced the 'Dalby Watson optical indicator', which gave remarkably fine and accurate indicator diagrams.

Prof. Dalby was not slow to realize that such an indicator would prove invaluable in the rapid testing of materials, and shortly afterwards he designed his 'optical load extension recorder'. In this instrument he measured the load on the test specimen by the elastic extension of a hollow steel weigh-bar, the small elastic extensions being magnified optically to any desired scale. A photographic record of a load extension test could thus be obtained. Inertia effects in such an instrument being practically eliminated, test pieces could be rapidly loaded without sacrifice in accuracy of measurement. To effect such rapid loading he designed a special hydraulic testing machine, and thus he obtained a load extension diagram of a test-piece broken in one second of time. The instrument is described in several papers contributed to the learned societies and also in his book published in 1923, "Strength and Structure of Steel and Other Metals", wherein will be found records of researches carried out by its use.

The largest of Prof. Dalby's publications was "Steam Power". It was published in 1915 and brought into one volume comprehensive studies of steam plants, the properties of steam and the various dynamic and other problems associated with such plant. His last book, published in 1931, was entitled "Power and the Internal Combustion Engine". In addition to the five books mentioned above, he was the author of numerous papers contributed to learned societies and institutions.

In his teaching and lecturing, Prof. Dalby was clear in exposition and could make attractive any subject he presented to his audience. He was wholeheartedly interested in his profession, and his enthusiasm was an inspiration to those who were associated with him. His work at the College and for the many committees on which he served left him little time for recreation, and that recreation he often sought in change of work, for he was always happy at his drawing board designing or improving apparatus for conducting his researches. The many students who have come under his influence, and the wider circle of those who have read his publications or listened to his lectures, will regret the passing of one who has done much for the advancement of engineering science.

WE regret to announce the following deaths:

Dr. H. J. Hansen, of Copenhagen, a foreign member of the Linnean Society of London, on June 26.

Prof. Julius A. Nieuwland, professor of chemistry in Notre Dame University, U.S.A., known for his work on synthetic rubber and lewisite, on June 11, aged fifty-eight years.

News and Views

Royal Society of Edinburgh: Honorary Fellows

THE following have been elected British honorary fellows of the Royal Society of Edinburgh: Sir Charles Boys; Sir Henry Dale, director of the National Institute for Medical Research; Prof. F. G. Donnan, professor of chemistry in the University of London, University College, London. Foreign honorary fellows have been elected as follows: Prof. L. H. Baekeland, honorary professor of chemical engineering, Columbia University, New York; Prof. M. Lugeon, professor of geology, University of Lausanne; Dr. George Sarton, editor of *Isis* and *Osiris*; Dr. G. L. Streeter, director of the Department of Embryology, Carnegie Institution of Washington; N. I. Vavilov, director of the Institute of Genetics, Academy of Sciences, Leningrad; Prof. W. M. Wheeler, emeritus professor of entomology, Harvard University.

Dr. W. S. Bruce Memorial Prize

A COMMITTEE consisting of representatives of the Royal Society of Edinburgh, the Royal Physical Society and the Royal Scottish Geographical Society, has awarded the Dr. W. S. Bruce Memorial Prize to James W. S. Marr, who first went to Polar regions with Sir Ernest Shackleton in the *Quest* in 1921, sailing as a boy scout. On Shackleton's death, the expedition continued under Commander Worsley into the Weddell Sea. Marr next sailed with Commander Worsley in 1925 to Spitsbergen and White Island in the Algarsson expedition. In 1927 he joined the staff of the R.R.S. *Discovery* and since then, with brief intervals at home, he has spent his time in the Southern Ocean, partly in the old *Discovery* and partly in *Discovery II*. From 1929 until 1931 he was in *Discovery* when she was lent to Sir Douglas Mawson for the British-Australian-New Zealand Expedition which found many new stretches of the coast line of Antarctica. Last year Marr published in the "Discovery Reports" a large monograph on the South Orkney Islands, which extended the original researches of Dr. W. S. Bruce on that Antarctic Group.

Dr. F. G. Novy

DR. FREDERICK GEORGE NOVY, formerly professor of bacteriology and dean of the Medical School of the University of Michigan, was presented with the 250,000th microscope produced by Messrs. Bausch and Lomb at a luncheon given to members of the American Association for the Advancement of Science during its summer sessions at Rochester, New York. Dr. Novy was selected for this honour by the executive committee of the American Association, for outstanding research in the field of bacteriology and immunology. He discovered and isolated the *Bacillus Novyi*, the agent of gas gangrene; he was the first to culture *Trypanosoma Lewisi*, and is the discoverer and isolator of *Spirochæta Novyi*, the cause of American relapsing fever. He has also made notable contributions to the study of filterable viruses, the respiratory processes of bacteria, and the causes of diphtheria, yellow fever and bubonic plague. A student of both Koch and Pasteur, Dr. Novy has the distinction of being the only person in the United States to-day who studied under Pasteur. France has made him a Chevalier of the Legion of Honour; Czechoslovakia created him a member of the Order of the White Lion, and Sinclair Lewis has romanticized him in his book, "Arrowsmith". For nearly fifty years, Dr. Novy was a member of the Medical Faculty of the University of Michigan, and is almost the last of the distinguished group gathered together by the late Dean Victor C. Vaughan. Dr. Novy's address at the luncheon, on "Some Results of Microscopic Research of Specific Significance for Human Welfare", was preceded by brief addresses by Dr. Edwin G. Conklin, president of the American Association, Herbert Eisenhart, president of Bausch and Lomb, and Dr. Edward Bausch who presented the 250,000th microscope of the company. It was Dr. Bausch's fifty-ninth year as a member of the Association.

The Use of Knowledge

IN his address at the graduation ceremony of the University of St. Andrews on June 26, Sir James Irvine, referring to the way in which new knowledge is being acquired at a rate much faster than man's capacity to absorb it, and to the way in which the impact of changing conditions has caught us unprepared, suggested that the machinery of Government should include a 'Ministry of Knowledge', the functions of which would be to predict the repercussions of new knowledge on all phases of life. Through such an organization, it might be possible to frame in advance a national policy in which due regard is paid to such far-reaching problems as the future sources of energy, such fundamental questions as to whether our coal supplies are to be used merely for power or as raw material for manufactured products, or whether our forests will be utilized for the purposes for which they were planted or devoted to alternative uses already looming in sight.

UNDOUBTEDLY the rapid diminution almost to vanishing point of the lag between the origin of new knowledge and its application has left man with less time than ever to adapt himself to the repercussions of the new ideas he has evolved. The need for foresight and intelligent anticipation in such matters as the development of industry, transport and town-planning cannot be disputed. While Sir James Irvine's suggestion deserves serious consideration, it

is at least doubtful whether the existence of such organized knowledge thirty years ago could have spared the world much of the devastation of unemployment; or whether it is possible to plan in advance when conditions are rapidly changing. Apart from the difficulty of predicting with any accuracy the effect of scientific discoveries on society, the wise use of knowledge involved in planning requires not merely the use of existing knowledge to avoid mistakes committed in the past, but also adaptability, an enlightened opportunism and a readiness to examine all matters in the spirit and method of science. It is, however, a hopeful sign that leaders of scientific thought are to an increasing extent concerning themselves with the consequences of the application of scientific discoveries. Organizations such as the Scottish Development Council and the National Trust, cited by Sir James, already exist for the wise use or conservation of our national resources, and they deserve the support of all who are in any measure equipped to guide opinion and direct progress.

Social Economics in the University of Manchester

THE Council of the University of Manchester has announced its decision to revive the second chair in the Faculty of Commerce and Administration, which has been in abeyance since 1932, with the title of "Chair of Social Economics". Mr. John Jewkes, who has been in charge of the Economics Research Section of the Faculty, which has been responsible for such important investigations as the industrial surveys of Lancashire and also Cumberland and Furness, undertaken for the Board of Trade, and the study of juvenile unemployment, has been elected to the chair as from September next. The duties will include the conduct of research and supervision of the work in the Economics Research Section, the creation of which was a new development in Great Britain in the organization of economic research within a university. It has now passed the experimental stage, and Mr. Jewkes's appointment is a recognition of it as an integral and permanent part of the work of the Department of Economics at the University of Manchester. Among a number of important inquiries which are in hand may be mentioned a study of the case histories of 2,000 juveniles in Lancashire who left school at Easter 1934; a study of the location of British industry, the changes proceeding and the forces behind them; a re-assessment of the industrial situation in Lancashire, being carried out at the invitation of the Lancashire Industrial Development Council; and a study of the systems of wage payment and labour conditions in the Lancashire cotton-weaving industry.

Manganese and Plant Growth

MANGANESE is now recognized as an essential element for normal plant growth, and most soils contain sufficient of it in an available form to supply the needs of all vegetation. There are certain soils, however, mainly reclaimed swamp soils and soils with a very high calcium carbonate content, in which manganese is either not present in sufficient quantity, or not in an available enough form, to support the growth of certain crops. Characteristic diseases then result, of which the best known are the grey speck disease of oats, a disease of beet in Holland, chlorosis of spinach on Long Island and diseases of tomatoes and other crops on the Everglade soils of Florida, although in the last case deficiency of copper appears to be concerned as well as of manganese. The availability of the manganese in the soil is influenced to some extent by weather conditions and by cultural practices. In general, dry conditions aggravate the diseases, and also manurial treatments, such as liming, which tend to make the soil more alkaline. In Denmark a formula is now used, known as the 'manganese value' (Steenbjerg, Trans. Third Int. Congr. Soil Sci. Oxford, 1935), which is based on a determination of the exchangeable manganese by leaching with magnesium nitrate, and on a factor which is a measure of the energy displayed by the soil colloids in keeping the exchangeable manganese. It is advocated that the manganese value of a soil should always be determined before liming, especially in the case of sandy soils, so that a calculation can be made of the largest allowable increase in *p*H which would not entail danger of grey speck disease. In the same report, Gerretsen claims that the symptoms of manganese deficiency are largely the result of the absorption of toxic products from bacteria which multiply more profusely on the roots of manganese-deficient plants.

Eastern Frontiers of the Roman Empire

SIR AUREL STEIN has made an offer to the authorities concerned to make a detailed survey of that part of the eastern frontier of the ancient Roman Empire which lies within Transjordania and Iraq. It will be necessary that a great part of this survey should be carried out from the air, as many of the sites are situated in the desert, and can be located only by this method. The proposal has the support of the British Academy and the Society of Antiquaries of London. It will form part of the scheme for the complete survey of the Roman Empire on a scale of 1 : 1,000,000, for which the British Ordnance Survey has already accepted its share of responsibility. The French have now completed the survey of that part of the frontier within the mandated territory of Syria. The survey was made by the French Air Force acting in conjunction with the Académie des Inscriptions et Lettres, and records observations of ancient roads, forts and defensive posts, as well as water supply. It is proposed that similar observations should be made in the survey projected by Sir Aurel Stein.

Racial Elements in Sumerian Art

ARCHÆOLOGISTS at times may seem over-bold in attributing racial values to the terms of their cultural analyses, although the practice frequently has much to be said in its favour, when it is followed, with due reservation, as a convenient form of shorthand while a question of origins is still in suspense. Sir

Leonard Woolley's lecture on "The Racial Elements in Sumerian Art History" before the Royal Society of Arts on February 19 (*J. Roy. Soc. Arts*, **84**, April 3, 1936) afforded an example of the pregnant inferences to be drawn from study of the geographical distribution of cultural elements to be related to those found at Ur and kindred sites in Mesopotamia in its bearing on the solution of the racial problem in Sumeria. As he pointed out, various theories have been put forward at different times, as knowledge has grown, to interpret evidence of the physical characters of the early population of Sumeria. Sir Leonard himself, by citing specific elements which go to make up the complex of Sumerian art, was able to show that it is a compound of three cultural streams. Of these the Asianic or Iranian goes back at Ur to pre-diluvial times, its most marked characteristics there being the painted pottery, while it extends from Mesopotamia to China; a second is derivative from Anatolia and the third comes from northern Syria. In these three cultural elements he finds, hypothetically, a parallel to the distinction which is drawn in the evidence for three differentiated physical types in the population. In this instance, it is to be admitted, there would appear to be good ground for the view put forward that the brilliant achievement of Sumerian art, in which these cultural streams unite, was due to that cross-fertilization of racial strains, which Sir Leonard maintains lies at the root of all great achievements in the art of a people as a whole. It is to be expected that Sir Leonard's new field of exploration in northern Syria will throw further light on the racial as well as the cultural problem.

Roman Leicester

EXCAVATION of Roman remains at Leicester now in progress has resolved an archæological doubt of long standing. While instructed opinion has hesitated between identifying the well-known Jewry wall, one of the highest surviving Roman walls in Britain, popularly regarded as a temple of Janas, as a Roman bath building, a basilica or even a town gate, it has now been shown, according to a report in *The Times* of July 4, to be part one of the external walls of the basilica in the forum of Roman Leicester, dating probably from about A.D. 100. A large part of the adjacent site, until recently occupied by a factory, is being cleared by the Corporation for the erection of public baths, and advantage has been taken of the opportunity to carry out these excavations. The base of the Jewry wall has been uncovered to some ten feet below the present surface, giving a total height of existing masonry of more than thirty-five feet. Two arched openings, previously thought to be doorways, are now revealed as windows. Beneath the Jewry wall, timber and masonry are associated with pottery and coins going back to the earliest Roman occupation of Britain. To the west of the wall is emerging a courtyard about 175 ft. wide, flanked by ranges of rooms or shops opening on to the courtyard by porticoes. This is the forum, of which the basilica forms part. Fronting the forum and abutting centrally on the basilica are the massive foundations of an architectural feature, probably once surmounted by a pediment, which dominated the forum and faced the main entrance. Outside the northern wall of the forum a stretch of cobbled roadway, deeply scored by wheels, has been uncovered. Massive walls and fragments of columns found on the factory site some years ago may now be identified as fragments of the forum and its colonnades. The road on the southern side of the forum is largely covered by St. Nicholas Street, near which is preserved one of the mosaic pavements for which Roman Leicester is famous. The excavations are being carried out by Miss Kathleen Kenyon under a committee, of which the Duke of Rutland is president, in co-operation with the Corporation of Leicester.

Electricity Distribution in Great Britain

THE report of the Committee on Electricity Distribution has now been published (Ministry of Transport. London: H.M. Stationery Office. 2*s*. net). The chairman was Sir Harry McGowan, and Sir John Snell was a member of the Committee. The evidence, some of which was conflicting, has all been carefully considered, and definite recommendations are given which seem thoroughly justified. The Committee does not suggest nationalization or the setting up of a Distribution Commission. It advises a reduction in the present number of undertakings by amalgamating the smaller and less efficient stations with the larger ones. It is stated that any attempt to carry through a scheme of re-organization on a voluntary basis is bound to fail, and legislation must confer definite and adequate compulsory powers. The schemes of re-organization should make provision for the possibility of ultimate public ownership of all undertakings, including those not at present subject to purchase by the local authorities. It is proposed that no undertakings should be transferred compulsorily under a scheme of re-organization without a prior local investigation. To this end the Electricity Commissioners should be empowered to delimit the country into a number of areas and to appoint for each area a temporary district commissioner, with such technical and financial assistance as may be necessary. The district commissioner would bring under review all electric undertakings in his area. The Electricity Commissioners, after publishing a scheme and considering any representations, should be empowered to approve it and, if agreed, it should become operative at once.

WITH regard to the London and Home Counties Electricity District, which covers an area with a large number of undertakings, some with duplication of powers, many with differing systems and tariffs, and offering very unequal facilities, the criticisms recently made by the public are often justified. A substantial measure of amalgamation and co-ordination is possible and necessary. The present constitution of the London and Home Counties Joint Electricity and Authority should be brought under review. Complete standardization of systems and voltages should be the ultimate objective, but it is

difficult to see how this can be done equitably. The amalgamation of undertakings into a smaller number of larger undertakings is an important step towards standardization of methods of charging and more uniform prices. The Minister of Transport should be empowered to require all undertakers to offer an improved statutory two-part tariff for domestic supplies, as an optional alternative to a flat-rate charge. The fixed charge under an approved two-part tariff should be based either on the floor area of the house or on its rateable value, and all undertakers should be required to publish the actual scale of fixed charges under their two-part tariff. If these suggestions were adopted there should result a general, though necessarily gradual, reduction in costs. Amongst other recommendations, it is suggested that where gas and electricity undertakings are left under the joint ownership of a local authority, it would assist in the more rapid development of the electricity undertaking if the authority were required to have separate committees. Evidence was given which showed that restrictions had been imposed on the development of the electrical undertaking in order to prevent the financial position of the gas undertaking from being adversely affected. Both public activities should be equally untrammelled.

Meteorology in India

IN the Report on the Administration of the Meteorological Department of the Government of India in 1934–35 (Delhi: Manager of Publications, 1935), an account is given of an important change in the arrangements for dealing with the increasing meteorological requirements of aviation along the trans-India air route. In previous years, a separate forecast had been issued to each aircraft in respect of the route covered by it each day from the forecasting centre concerned; but it became evident that it would soon be impossible for the two centres at Karachi and Calcutta to continue to do this for the four thousand miles of the route between Bahrein and Victoria Point. Arrangements were therefore made to broadcast forecasts for each section of the route regularly at fixed times, and to distribute data relating to upper winds and cloud height by wireless from pilot balloon stations along the trans-India route twice daily. The Agricultural Meteorology Branch carried out a number of researches, mainly at the Central Agricultural Meteorological Observatory, Poona; instruments for the study of microclimatology were designed and tested, and a number of papers were written dealing with the correlation between meteorological conditions in the open and among growing crops; researches into evaporation, percolation and effective rainfall were also made. Experiments on the effect on soil temperature of a thin covering of soil of different colours and from different districts showed that coverings of certain soils had a big effect on the climate of the soil beneath. Other investigations were made into the albedo of different types of soil and vegetation. The scheme of crop-weather precision observations was applied to wheat and jowar at Poona, to rice at Karjat and to bajri at Baroda. The study of frost damage and methods of preventing it was also included in this branch's activities. The Upper Air Observatory at Agra released seventy-seven sounding balloons with recording instruments, and nearly half of these were recovered.

Physiology of Indian Crop Plants

FOR some time past, the staff of the Institute of Agricultural Research of the Benares Hindu University has been engaged, under the leadership of Prof. B. N. Singh, in detailed and comparative studies of the physiology of Indian crop plants. A considerable number of publications on this subject has now been issued, mainly in the *Proceedings of the Indian Academy of Sciences*, and good progress has evidently been made in a highly interesting and important field of work. The most extensive work completed is that dealing with photosynthesis under different conditions of light, temperature and carbon dioxide supply. Since a large part of previous research on this subject has been carried out in temperate climates, it will be obvious that detailed studies of tropical plants are likely to be of considerable value. One striking result of this work is that tropical plants are found to have a higher light requirement in photosynthesis than similar species grown under temperate climatic conditions. Another especially interesting problem under investigation is that of the differences in respiration rate found to exist in plants differing in their duration of life. Short-lived plants are apparently characterised by a low respiration rate, which also falls off very rapidly as the age of the plant increases. Long-lived plants, on the other hand, not only have a high respiration rate but also are able to maintain this higher rate throughout life. Other subjects under investigation by comparative methods include the water requirements of seeds possessing different structural and biochemical properties, and the effects on plant growth of irradiating seeds with X-rays.

Electricity in Horticulture

ELECTRO-CULTURE has to take into account the effects of electric heating, electric lighting and the voltage stress on the life of plants. The first application of electricity took the form of high-voltage discharges produced in close proximity to various plants in an endeavour to obtain artificial stimulation. In the Engineering Supplement for May of *Siemens Magazine*, a survey is given of recent developments, and the photographs shown of the effects produced are convincing. It has often been noticed that an increased growth of crops sometimes occurs during thundery weather. In the Arctic, where the average atmospheric potential gradient is high, it has been observed that the growth of vegetation during the short summer is more vigorous than in southern climates. Experiments have been carried out on cereals, potatoes, beets, tomatoes, strawberries and raspberries, and increases up to forty per cent have been obtained. Electricity in the form of light was the next application in the aid of horticulture. For vigorous plant growth a minimum of about 4 hours

of sunshine and altogether about 10 hours of daylight per day are required. As an example of the effect obtained by providing lighting for 10 hours each night with an illumination of about 4 foot candles, pansies after 83 days gave an average of approximately 16 flowers per plant as against 2 flowers for unlighted plants; and asters after 157 days' treatment bloomed 33 days earlier than usual. The red-yellow rays accelerate growth by stimulating the chlorophyll and the absorption of carbonic acid. Electric cables are also described which are used for heating the soil, and excellent economical results have been obtained.

Ancient Heating and Lighting Appliances

ONE of the world's largest collections of heating and lighting appliances has recently been presented to the Smithsonian Institution together with an endowment for its maintenance. It begins from the fire drills with which primitive peoples started a flame by friction, and goes on to some of the latest appliances for lighting and heating. A description of the collection has been issued by the Smithsonian Institution. After the fire drill, the account passes to the percussion method, in which a hard stone, such as flint, gives a spark when struck against steel. The steel used was frequently made in an artistic form, and was called a 'briquet'. Some of these briquets dating from about A.D. 500 were unearthed in a farm in France in 1902. One specimen is inlaid with gold, and has bits of ruby-coloured glass embedded in it. There are also pistol-action lighters, which employ the principle of the flint and steel but simplify it by means of a trigger. This way of starting a fire came into general use about 1700, and was developed from the flint-lock gun, the first of which appeared in England about 1626. Illustrating the period preceding matches, when light was obtained by chemical action, the collection contains a Döbereiner jar, introduced about 1823. Flame was produced by letting hydrogen come into contact with certain other substances. The lamps range from one about the size of a thumb to another as tall as a man. The latter was obtained from a Buddhist temple. Another curiosity is a rolling lamp which was used at Hindu weddings; the light remains upright when the globe is rolled along the ground. There is also a horological lamp which tells the time of night by the amount of oil consumed.

Anti-Vivisection Finance

THE honorary treasurer of the Research Defence Society, Sir Leonard Rogers, in a recent issue of the *Fight Against Disease* (**24**, No. 1) directs attention to the sums spent on propaganda by anti-vivisection societies within recent years. Analysing the certified annual accounts from 1912 onwards, and making allowance on one side for missing reports, and upon the other for useful work for animals done by some societies, it is estimated that a sum of approximately £600,000 has been received for 'anti-vivisection' work, and nearly £500,000 expended. The success in raising funds, in spite of the verdicts of two Royal Commissions against them, would appear to be partly due to a facile appeal to sentiment, aided by the lack of adequate medical and scientific knowledge of the masses to enable them to sift the 'anti-' statements. Anti-vivisection propaganda has sought to curtail the work of hospitals and veterinary colleges, and the one piece of useful work that might have been accomplished with the huge accumulated funds, the support of the 'Anti-Vivisection Hospital' at Battersea, has been allowed to lapse.

Prevention of Disease in the Tropics

A MEETING of the Industrial Advisory Committee of the Ross Institute (London School of Hygiene and Tropical Medicine) was held on April 16 under the chairmanship of Mr. G. H. Masefield, when reports were received upon the Institute's activities in India, Ceylon, and South, East, and West Africa. Malaria prevention has received much attention, and instances were given of the value of mosquito control in combating this disease. Other diseases, including yellow fever and the eye-fly pest of India and Ceylon, were also discussed. Allusion was made to the value of reinforced aluminium foil as a heat insulator; in a tea factory in Ceylon a reduction of temperature of 7° F. at noon in the rolling room had been obtained by its use.

British Medical Association: Annual Meeting

THE one hundred and fourth annual meeting of the British Medical Association will be held in Oxford on July 17–25, under the presidency of Sir E. Farquhar Buzzard, regius professor of medicine in the University of Oxford. The meeting will be divided into the following sections under the presidents indicated: Medicine (Dr. A. G. Gibson); Surgery (Prof. G. E. Gask); Obstetrics and Gynæcology (Prof. H. Beckwith Whitehouse); Ophthalmology (Dr. P. E. H. Adams); Pathology and Bacteriology (Dr. E. W. Ainley Walker); Anatomy (Prof. W. E. Le Gros Clark); Diseases of Children (Dr. R. C. Jewesbury); Neurology and Psychological Medicine (T. S. Good); Orthopædics (G. R. Girdlestone); Oto-Rhino-Laryngology (L. Golledge); Pharmacology and Therapeutics, with Anæsthetics (Prof. J. A. Gunn); Physical Medicine (Dr. W. J. Turrell); Physiology and Biochemistry (Prof. R. A. Peters); Radiology (R. H. Sankey); Tuberculosis (Dr. W. Stobie); Dermatology (Dr. S. E. Dore); History of Medicine (Dr. A. Chaplin); Medical Sociology (Sir George Newman); Nutrition (Dr. A. F. Hurst); Public Medicine (Dr. W. M. Willoughby). A popular lecture, entitled "Anthropology and Medicine", will be delivered on July 24 at 8 p.m. by Dr. R. R. Marett. In addition to the usual professional exhibitions, an exhibition of pictures illustrating the history of Oxford medicine will be open at the University Museum from July 20 until July 25. Further information can be obtained from the Secretary, B.M.A. Office, The Cottage, Keble Road, Oxford.

Announcements

AT the annual meeting of the Royal Anthropological Institute, the following officers for the year 1936–37 were elected. *President:* Dr. H. S. Harrison; *Vice-President:* Dr. H. J. Fleure; *Hon. Secretary:* Dr. R. W. Firth; *Hon. Treasurer:* H. Coote Lake; *Hon. Editor:* R. U. Sayce. The Rivers Memorial Medal for 1936 was awarded to Prof. Peter H. Buck (Te Rangi Hiroa) for anthropological work in the allied fields of New Zealand, Central and Eastern Polynesia. The Wellcome Gold Medal for 1935 was awarded to Dr. Lucy Philip Mair for an essay entitled "An Anthropologist's Estimate of African Policies".

THE following appointments in the Colonial Service have recently been made: P. F. Mason, to be assistant conservator of forests, Nigeria; J. C. K. McElderry, to be assistant conservator of forests, Nigeria; M. L. Pattullo, to be assistant conservator of forests, Nigeria; R. G. M. S. Macgregor, to be professor of physiology, Malaya; W. Orr, to be veterinary officer, Malaya; A. L. Craig-Bennett, to be chief fisheries officer, Palestine; A. H. S. Megaw, to be director of antiquities, Cyprus; F. P. Jepson, controller of plant pests and assistant entomologist, to be deputy director of agriculture, Ceylon; D. E. Wilson, medical officer, to be pathologist, Medical Department, Tanganyika.

PROF. JEAN SABRAZÈS, professor of pathological anatomy and clinical microscopy in the University of Bordeaux, has been elected *Correspondant* for the Section of Medicine and Surgery of the Paris Academy of Sciences, in succession to the late Prof. Léon Frédericq.

AN institute for the investigation of rheumatism, the first of its kind in Austria, has been founded at Baden near Vienna. A balneological investigation department will be added later. The honorary director of the institute is Prof. R. Ewald.

THE Soviet Government has decided to erect a monument to the late Prof. Pavlov as well as to name an institute after him and to publish his works in four languages. His brain is to be preserved in the Moscow Institute for Cerebral Research, and his widow is to receive a pension of 1,000 roubles monthly.

THE ninth International Dental Congress will be held in Vienna on August 2–8 under the presidency of Dr. Hans Pichler, and will consist of fifteen sections. Further information can be obtained from Mr. A. E. Rowlett, 165 London Road, Leicester.

THE prefecture of Tokyo is to found a museum of hygiene, the inauguration of which is to coincide with the celebration of the 2600th anniversary of the Japanese era in 1940. The Society of School Hygiene at Tokyo proposes to organize on this occasion a general meeting, and to undertake active propaganda in favour of school hygiene.

IN order to permit more time for the preparation of material, the First International Conference on Fever Therapy, originally arranged to be held in New York on September 29–October 23 (see NATURE, **137**, 989, 1936), has been postponed until March 30–April 2, 1937. Further information can be obtained from Dr. William Bierman, 471 Park Avenue, New York City, U.S.A.

A COMPETITION was held some time ago by the 'EPIDOS' (International Association of Bone Glue Manufacturers) with the object of stimulating research in the increase and improvement of outlets for bone glue. Several promising ideas were put before the Association. A total sum of 30,000 Swiss francs was distributed to the winners of this competition. EPIDOS has decided to continue its investigations in this direction. It has set aside a certain sum for the purpose of encouraging research by those who will put forward interesting ideas for the use of glue, and also recompensing those with proposals already ripe for development. Further information can be obtained from the General Secretariat of the International Association, 40 Rue du Colisée, Paris.

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

A teacher of general elementary science and mathematics in the Technical College, Wolverton—The Principal (July 13).

A lecturer in mechanical engineering in the Walsall Technical College—The Director of Education, Education Offices, Council House, Walsall (July 16).

A head of the Applied Mathematics Department in the Rochdale Municipal Technical School—The Principal (July 16).

An assistant in the Science Department (zoology and botany) in the Barnsley Mining and Technical College—The Principal (July 18).

Two University demonstrators in anatomy in the University of Cambridge—Dr. Roughton, Department of Physiology (July 19).

An assistant lecturer in electrical engineering in the Imperial College of Science and Technology (City and Guilds College)—The Secretary, Imperial College of Science and Technology, Prince Consort Road, S.W.7 (July 24).

An assistant inspector (Grade 2) in the Aeronautical Inspection Directorate of the Air Ministry—The Secretary (S.2.d.), Air Ministry (July 25).

An assistant director of research in medicine in the University of Cambridge—The Regius Professor of Physic (August 1).

A general manager of the Dudley Zoo—The Secretary, Dudley Zoological Society, Ltd., The Earl of Dudley's Estate Offices, Dudley, Worcs. (August 1).

A University reader in mathematics in the Imperial College—Royal College of Science—The Academic Registrar, University of London, S.W.7 (August 21).

A professor of biology in the University of Otago—The High Commissioner for New Zealand, 415 Strand, London, W.C.2 (August 31).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 81.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Corona during the Total Solar Eclipse of June 19

OUR small amateur party (Miss Gerasimova and I) had an opportunity of observing the total solar eclipse of June 19, from the eclipse camp at Ak Boulak (near Orenburg, U.S.S.R.). The expedition of Poulkova Observatory and that of Harvard University conducted their work there.

For taking photographs of the total phase, we had two reflecting telescopes equipped with parabolic mirrors, which were ground, polished and figured by myself. The installation was a most primitive one. No guiding mechanism was available; consequently, only short exposures (from half a second to one second) could be used in order to obtain good definition.

Atmospheric conditions were splendid, which was an agreeable surprise to us, since the weather was very poor during three preceding days. To see the eclipse, thousands of people gathered on the hill where the camp was situated. Many of them came from Orenburg and even from farther distant localities.

The magnificent panorama of the total eclipse was opened to our eyes at the expected moment. The sky became of deep steel tint with a conspicuous shade of lilac. Venus appeared on the right upper side quite close to the sun; between the two, Mars was clearly seen. The horizon was orange red. The singing of skylarks seemed louder in the profound silence.

The corona was unusually bright; it emitted apparently more light than the full moon. Its colour could be described as silvery and silky. The shape of the corona was typical of the period of high activity of the sun, and somewhat reminded us of a five-pointed star. Two prominences of a bright ruby colour could be easily seen by the naked eye at the edge of the velvety black disk of the moon.

The photograph reproduced here (Fig. 1) was taken directly in the focus of our six-inch mirror (140 cm. focal distance), and gives some idea of the appearance of the inner corona viewed through a low-power telescope; in reproduction it has been enlarged about 5 diameters. This photograph was taken shortly after the beginning of the total phase. A second was taken somewhat after the central moment, and the third a few seconds before the end of the total phase. Prominences are very conspicuous on all the photographs; the greatest of them attains the height of at least 100,000 km.

The duration of the total phase was almost two minutes, a period of time sufficient for making more than three photographs, even with our primitive equipment. However, we were able to make only three exposures; the precious instants were gone surprisingly soon. This psychological effect should be undoubtedly attributed to great excitement caused by viewing this rare natural phenomenon.

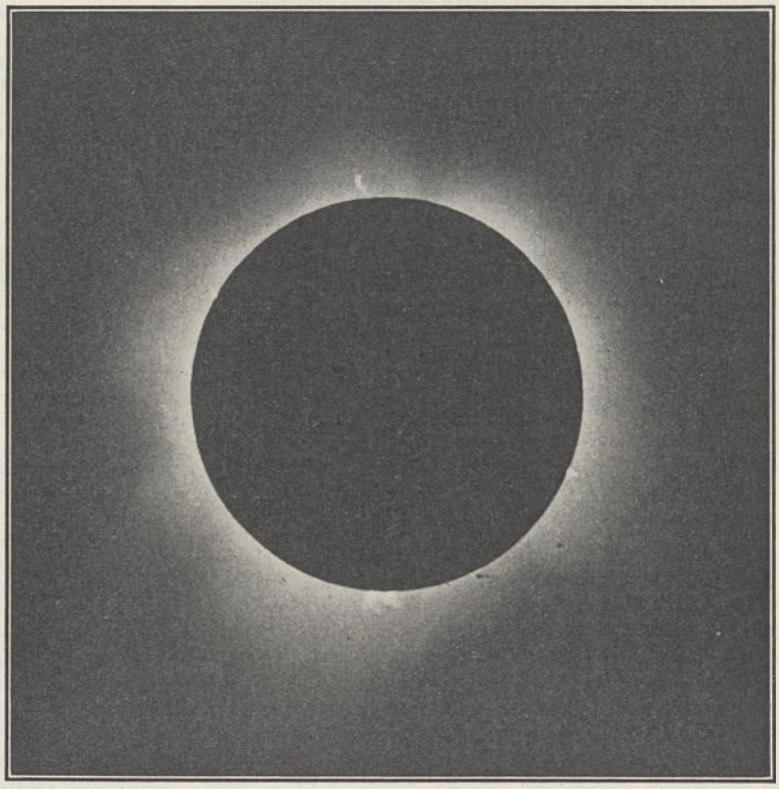

FIG. 1. Total solar eclipse of June 19, photographed at Ak Boulak.

Thanks are due to Prof. B. P. Gerasimovič, head of the Expedition, for admitting us to the Ak Boulak eclipse camp.

M. NAVASHIN.

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Moscow.

The Nature of Viscid Fluid Threads

THE considerations which follow gained the interest of Sir William Hardy, a specialist in such matters, when discussed with him briefly not a few years ago. As I am not aware of any record, at any rate in reasonably simple form, I venture to submit a brief statement.

The fact that permanent viscid threads can be pulled out of a plastic mass, after the manner of fibres of silk or of rayon before they solidify, does not lose its mechanical mystery through familiarity. If such a thread is suspended from one end, which oscillates up and down, it expands and contracts in length over a large range in dynamical unison with the oscillation, without breaking. The great amplitude may be imagined as due to the effective molecules being shaped like long dumb-bells, such as naturally interact mainly by force between their ends. If two rows of them lie parallel, there is a position of equilibrium when the ends are opposite each other. If one row is slid along, an elastic reaction comes into play which increases to a maximum, then diminishes as the attraction of the next pole becomes important, until it vanishes, when each attracted pole in the row is equidistant from the two influencing ones. This is an intermediate unstable position.

This peculiar complex type of viscid alternating elasticity holds a possible key to one type of phenomena: the expansion consists of rows of molecules within the threads sliding past one another, thus permitting reversible extension of large range without rupture in a way which we need not here follow in detail. The ruling idea came from the theory of the homologous hydrocarbon series provided by organic chemistry in its very early days, giving dumb-bell pictures which were then taken to be symbolic, but now under the scrutiny of X-ray diffraction reveal a geometrical reality.

A similar, but much less definite multiplication of basic molecular elements, is actually formed in hypermolecules of substances of cellulose type, such as the plastic threads would require. But how is it that the parallel rows are not dispersed sideways from one another? Observe a hanging thread: it shrinks up at the free end into a spherical blob, like a dew-drop, obviously by surface tension holding it firm; higher up the length-wise surface tension has to hold up the lower part of the thread against its weight, while the transverse tension round the section holds the thread together. The section changes during an imposed vibration, the supporting force thus altering rhythmically as required. There is room for a mathematical theory here, if enough is known of the facts.

A somewhat cognate subject is the tension theory of the foreign monomolecular surface-layers discovered by Miss Pockels of Heidelberg and the late Lord Rayleigh, and developed extensively mainly by I. Langmuir and N. K. Adam. But one may insist that this effect is superposed on the Young–Laplace theory of an intrinsic surface tension at a pure interface and by no means replaces it.

One recalls also another cognate subject. Among my early recollections is the vision of Lord Kelvin standing, cup and saucer in hand, orating on the wisdom of the technique of the ladies' tea table, which spread a film of water in the saucer to prevent the cup of tea sliding over it. For, as he insisted, this brings a new type of intimate friction, entirely different from the smooth viscosity developed into hydro-dynamic theory by his friend and prophet Stokes, a theory which was to receive so vast expansion into the practical realms of ship-resistance and lubrication largely in the hands of Osborne Reynolds. All these topics, so simple in essence, now ramify very extensively throughout the most recent marvellous technology, with no slight reaction backward on abstract science.

JOSEPH LARMOR.

Holywood,
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June 13.

Inactivation of Crystalline Pepsin

CRYSTALLINE pepsin, in solutions of constant ionic strength on the alkaline side of its stability maximum, inactivates unimolecularly at a rate which is inversely proportional to the *fifth* power of the hydrogen ion concentration. This unusual relationship has been demonstrated over a velocity interval of 1 to 5,000 in nearly a hundred kinetic experiments at two temperatures with four different buffers. The rate varies with the buffer, but the fifth-power relation does not. As the buffer ratios change by different amounts in the same *p*H range, general basic catalysis is therefore excluded. It is likewise improbable that simple hydroxyl ion catalysis determines the rate.

The dependence on ionic strength is striking. Between $\mu = 0{\cdot}012$ and $\mu = 0{\cdot}10$, the velocity at constant *p*H increases by more than thirty times, regardless of the mono-monovalent salt used. At higher concentrations the change is smaller and finally reverses. The effect is complex, since the curve relating log-velocity to *p*H is shifted along both axes. Various relations to acidity earlier described[1] are partly fortuitous, owing to failure to control ionic strength.

This description applies only when the solutions are not agitated. On shaking, a heterogeneous reaction, independent of *p*H and μ over wide limits, obscures the results. The fifth power appears only at *p*H above 6·2 ($\mu = 0{\cdot}1$), where the homogeneous reaction is rapid enough to predominate. In more acid solutions the half-period of the latter may exceed five years at 25°.

The large exponent probably indicates that equilibria governing the concentration of an unstable species of pepsin ion determine the rate. Five acid groups must dissociate in the formation of this ion; the dissociation of the strongest group must also be fairly small in this range of acidity. Pepsin contains a limited variety of widely-spaced acid radicals; thus, it is conceivable that the five groups are alike and possess nearly identical dissociation constants. If they differ only by limiting statistical factors, the failure of the fifth-power dependence to hold exactly at *p*H above 6·45 means that the dissociation constants are near $1{\cdot}7 \times 10^{-7}$. This is slightly stronger than the positively charged ammonium groups in the simpler polypeptides[2] and in a simple protein[3], and approximately correct if the free amino groups of pepsin come from cystine rather than lysine. There are probably just five cystine residues in the enzyme, but Herriott and Northrop find four rather than five primary amino groups in pepsin[4].

If account is taken of the effect of temperature on the size of the pepsin fraction present as the unstable ion, the temperature effect on the rate of the actual reaction (decomposition of this ion) is much smaller than the observed change in velocity. When the

ratio $k_{25°}/k_{15°}$ (about 30) is used to calculate the critical increment, the result is 64,000 calories—a high figure, characteristic of protein denaturation. When the shift in the *p*H dependence is allowed for (assuming all five groups alike) a quite ordinary value, 20,000 calories, is obtained. The exponent produces a large disparity, though the heat of dissociation of each group is only 9,000 calories. The latter value is favourable to the view that primary amino groups are involved, if the possible complications of tautomerism may be neglected. (Michaelis and Rothstein concluded that temperature changes only bring about changes in hydroxyl ion concentration. This unwarranted conclusion depends on the assumption that the inverse kinetic relation to hydrogen ions signifies a direct dependence on hydroxyl ions.)

Should this procedure apply to proteins generally, the statistical-mechanical difficulties arising from the great temperature effect in denaturation may prove to be illusory. The frequently observed variation of critical increment with *p*H, and its decline to a limiting value at high temperatures, can also be explained.

These measurements, to be described in detail elsewhere, owe much to the generous interest of Prof. J. N. Brønsted.

JACINTO STEINHARDT.
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Institute of Physical Chemistry,
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April 5.

[1] L. Michaelis and M. Rothstein, *Biochem. Z.*, **105**, 60 (1920); R. Ege, *Z. physiol. Chem.*, **143**, 159 (1925); A. M. Goulding, H. Wasteneys and H. Borsook, *J. Gen. Physiol.*, **10**, 451 (1926–27).
[2] E. J. Cohn, *Erg. d. Physiol.*, **33**, 781 (1931).
[3] K. Linderstrøm-Lang, *Trans. Far. Soc.*, **31**, 1 (1935).
[4] R. M. Herriott and J. H. Northrop, *J. Gen. Physiol.*, **18**, 35 (1934).

The Nitroprusside Reaction as a Test for Reduced Glutathione

THIS test was first introduced by Mörner[1]. He added sodium nitroprusside and then alkali to cystein and obtained a deep purple red. This changed into a reddish brown and finally disappeared. Cystin gave no reaction. Mörner used a solution of pure cystein, and whether or not he heated his solution prior to the test he did not state. Heating in this case would not affect the results materially. In 1921 Hopkins[2] very casually suggested heating tissue in weak acetic acid in order to intensify the reaction before applying the test. This unchallenged suggestion has led other workers to heat tissues with acetic acid prior to the application of the test, thus obtaining wholly meaningless results (see, for example, Fink[3], Camp[4] and Coldwater[5]). In 1923 Harris[6] showed that native proteins which are non-reactive to nitroprusside become reactive when warmed with acid or base. For example, fresh ovalbumin is placed in three test-tubes and to tube *A* nothing is added; to tube *B* acetic acid is added; and to tube *C* acetic acid is added, and this tube is heated. All tubes are rendered alkaline with ammonium sulphate. The nitroprusside test is then negative in tubes *A* and *B* and positive only in the tube that was heated. Heat denatures proteins and liberates free —SH radicals if the protein contains such in combined form.

Coldwater allowed tadpole tails to regenerate for 14 days, applied the nitroprusside test, and found that the regenerating part gave a more intense colour. I allowed tails of overwintering tadpoles (*Rana clamitans*) to regenerate for 3 weeks at 13°–16° C., keeping the animals without food. The tips, *C* (Fig. 1), of the tails were analysed quantitatively for GSH as soon as cut. After the elapse of the given time for regeneration (at the end of which the tails were less than half regenerated) regions *A*, *B*, and the regenerated region *R* were analysed for GSH. Two series of 35 tadpoles in each were analysed. The results are indicated in the accompanying table and are expressed in percentages of wet weight.

Per cent GSH of wet weight of different regions of a tadpole's tail

Series	Region of tail			
	A	*B*	(Regenerate) *R*	*C*
I	0·028	0·024	0·021	0·025
II	0·033	0·021	0·016	0·030
Average	0·030	0·022	0·018	0·027
Probable Error	± 0·001	± 0·0006	± 0·001	± 0·001

It is clear that the regenerating area has a lower concentration of GSH than the non-regenerating muscular regions. If the bone present in the old portion of the tail were removed, or if the results were reckoned in terms of dry weight, the differences would have been even greater. These results, of course, in no way contradict any hypotheses put forward by others that the —SH radical may be a factor in regeneration, since the amount of GSH necessary for muscle metabolism might be far in excess of the small amount required for regeneration. This work does show, however, the fallacious results obtained by heating tissues prior to the application of the nitroprusside test.

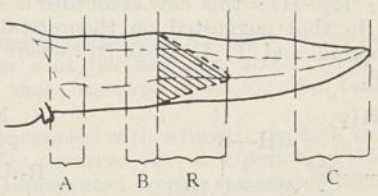

FIG. 1. Tail of *Rana clamitans* tadpole. *A*, *B* and *C* are the regions of the old tail analysed for GSH. *R* is the regenerating area.

The nitroprusside test was applied to pieces of *Euplanaria maculata* at different time intervals after cutting (2, 3, and 7 days). The initial result was an intense purple red throughout. Fading began in the lateral and regenerating areas of the reconstituting organism. If the permeability factor was not completely eliminated by acetic acid, then the areas shown to be more permeable to methylene blue stained first (that is, the lateral areas and the regenerating tissue). The other tissues stained later, but just as intensely, and the colour disappeared later. The intensity of colour was not at a maximum at the same time throughout the animal. Incidentally, it may also be mentioned that the nitroprusside reaction was applied to *Hydra grisea*. The immediate

result was an initial flash of colour of about equal intensity throughout. The colour in the tentacles and in the stalk faded out at a very definitely earlier period than that in the main body region. Prior to the test, the animals were chloretonised and were in an expanded condition. Coldwater's results can easily be interpreted as due to differences in penetration of the reagents in the regenerating and non-regenerating regions.

The specificity of the nitroprusside test for reduced glutathione in living tissues has also been questioned. Now Sullivan[7] noted that, apart from free cystein, substances giving a positive nitroprusside test are not present in normal tissues. These substances include acetone, ethyl aceto-acetic acid, and cyan-acetamide. There is, moreover, no authentic record indicating the presence of free cystein in living tissues. Applying Sullivan's test for cystein, Tunnicliffe[8], Thompson and Voegtlin[9], Gregory and Goss[10] and I failed to find free cystein in living tissues. It may thus be concluded that the nitroprusside test is specific for reduced glutathione *when applied to normal living tissues and when ammonium hydroxide is used as the alkali and no heat is applied.*

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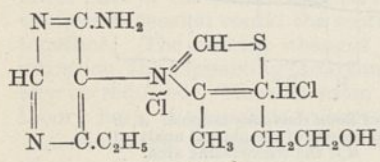
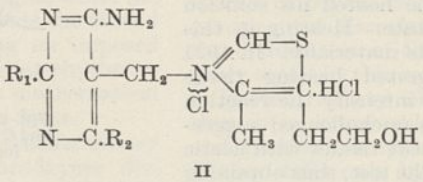
[1] K. A. H. Mörner, *Z. physiol. Chem.*, **28**, 595 (1899).
[2] F. G. Hopkins, *Biochem. J.*, **15**, 286 (1921).
[3] D. E. Fink, *Science*, **65**, 143 (1927).
[4] W. H. Camp, *Science*, **69**, 458 (1929).
[5] K. B. Coldwater, *J. Exp. Zool.*, **65**, 43 (1933).
[6] L. J. Harris, *Proc. Roy. Soc. Lond.*, B, **94**, 426 (1923).
[7] M. X. Sullivan, Publ. Health Repts. U.S., 41, pt. 1, 1030 (1926).
[8] H. E. Tunnicliffe, *Biochem. J.*, **19**, 194 (1925).
[9] J. W. Thompson and C. Voegtlin, *J. Biol. Chem.*, **70**, 793 (1926).
[10] P. W. Gregory and H. Goss, *J. Exp. Zool.*, **69**, 13 (1934).

The Structure of Aneurin and Thiochrome

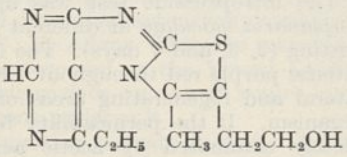
R. R. WILLIAMS has just published[1] a note on the structure of aneurin (vitamin B_1). From a study of degradation products of the vitamin, he concludes that his original formula (I)[2] for aneurin is wrong, and that it should be represented by (II : where $R_1=CH_3$; $R_2=H$) ; this new structure is similar in essentials to that suggested on theoretical grounds by K. Makino and T. I. Imai (II : where $R_1=H$; $R_2=CH_3$)[3].



I



II



III

For thiochrome, which is formed from aneurin by mild oxidation, we suggested on the basis of formula (I) the structure (III)[4]. In the course of subsequent synthetic work we observed that thiazpurines, prepared as models for a thiochrome synthesis, although blue fluorescent in ultra-violet light, never showed fluorescence in daylight. This led us to suspect that (I) might not represent aneurin, and our suspicion was confirmed on completing the synthesis of the compound having structure (I). The synthetic substance, though exhibiting similar colour reactions to aneurin, is not identical with it ; on oxidation with potassium ferricyanide it gives a substance non-fluorescent in daylight, but blue fluorescent in ultra-violet light. The difference in fluorescence between thiochrome and synthetic thiazpurines suggests that the former contains a different ring system. Accordingly, the possibility that the formula of Makino and Imai might represent the vitamin has been explored by synthetic methods. These experiments are not yet complete, but a compound similar in structure to (II) has been prepared, which on oxidation with potassium ferricyanide yields a substance exhibiting an intense blue fluorescence comparable with that of thiochrome. We are thus of the opinion that aneurin has a structure of type (II).

Our results afford additional evidence in support of the formula (II : where $R_1=CH_3$; $R_2=H$) advanced by Williams as a result of his brilliant investigations. Final proof of the structure must rest with the complete synthesis of the vitamin itself.

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A. R. TODD.

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University, Edinburgh.
June 29.

[1] *J. Amer. Chem. Soc.*, **58**, 1063 (1936).
[2] *J. Amer. Chem. Soc.*, **57**, 229 (1935).
[3] *Z. physiol. Chem.*, **239**, I (Feb. 28, 1936).
[4] G. Barger, F. Bergel and A. R. Todd, B., **68**, 2257 (1935).

A Radioactive Isotope of Iron

IT was shown by Fermi and co-workers[1] that the activity induced in iron by neutron bombardment is due to an isotope of manganese. The isolation of an active iron isotope has not been reported. By means of the sensitive tube counter outfit[2] in this institute, it was found that active iron can be isolated from cobalt which has been irradiated with neutrons, whereas irradiated iron after removal of manganese was found to be inactive. Experiments were carried out with cobalt as metal, as oxide and as carbonate.

After activation, the substance was dissolved in nitric acid and a trace of ferric salt added to the solution. Iron was precipitated from acid solution by means of ammonium acetate, the hydroxide then dissolved again and precipitated once more in the same way, and finally the same process was repeated a third time. The final product (Fe_2O_3) showed an activity decaying with a period of very nearly 72 hours. As only a single cobalt isotope is present in detectable amounts, it can be deduced that this activity must be due to the isotope $^{59}_{26}Fe$. This result is in very good accordance with recent investigations on the isotopic constitution of iron[3], which have shown that the isotopes $^{57}_{26}Fe$ and $^{58}_{26}Fe$ are stable, being present in amounts of 2·8 and 0·5 per cent of the element. These data also explain why it has been impossible to detect the formation of an active iron isotope by irradiation of iron itself.

Attempts to isolate active zinc from irradiated gallium and active chromium from irradiated manganese gave negative results. The experimental method, however, only allows detection of active products with fairly long periods.

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May 27.

[1] Fermi and co-workers, *Proc. Roy. Soc.*, A, **146**, 483 (1934).
[2] Buch Andersen, *Z. Phys.*, **93**, 597 (1936).
[3] de Gier and Zeeman, *Proc. Roy. Acad. Sci. Amsterdam*, **38**, 959 (1935).

Determination of van der Waals Forces

THE quantum theory, unlike classical theory, predicts a finite effective collision area for impact between gas atoms attracting with a mutual potential energy falling off more rapidly with distance than the inverse cube. It has been pointed out by Massey and Mohr[1] that this makes possible a new experimental method for investigating the magnitudes and nature of these interatomic forces, namely, by direct observation of free paths by molecular ray methods using sufficiently high resolving power. Further, they have given a formula for the effective collision area for any inverse power law of force, from which the results of such experiments could be interpreted.

Since then, Rosin and Rabi[2] have carried out experiments under the required conditions for collisions of rare gas atoms with alkali atoms. The values of the van der Waals energy constant C (such that the van der Waals potential energy of interaction of two atoms at distance r apart is $-C/r^6$) for alkali – rare gas interaction, derived from their results, are given in columns a of Table I. (In obtaining these results correction has been made for the random direction of motion of the scattering gas atoms, but not for the Maxwellian distribution of velocities.)

Table I

Values of $C \times 10^{60}$ (erg.cm.^{6}).

	He		Ne		A	
	a	*b*	*a*	*b*	*a*	*b*
Li	14·4	17	18·7	32	188	125
Na	17·8	(26)	40·4	(51)	192	(200)
K	31·7	35	50·5	68	356	260
Rb	25·4	(40)	49·0	(77)	249	(290)
Cs	29·5	44	56·7	87	235	325

These results are of special interest because they may be compared with values of C derived from the polarisabilities of the atoms by a formula due to Hellmann[3]. The polarisabilities of lithium, potassium and cæsium have been measured directly by molecular ray methods by Scheffers and Stark[4] and those of the rare gas atoms may be deduced from measurements of their refractivities[5]. Substituting these values in Hellmann's formula, we derive the values of the constant C given in columns b of Table I. The bracketed values have been derived by interpolation, as the polarisabilities of sodium and rubidium have not yet been determined.

It will be seen that the agreement of the two sets of values of C is quite good and suggests that the free path method will prove very convenient for the determination of van der Waals forces. Further experiments in this direction, particularly on mutual collisions between rare gas atoms, would therefore be most valuable. It might be mentioned in conclusion that the scope of the free path method is much wider than that of the older methods depending on gas viscosity and diffusion phenomena.

We would like to express our thanks to Miss R. Sullivan for assistance in some of the numerical calculations.

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R. A. BUCKINGHAM.

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June 2.

[1] *Proc. Roy. Soc.*, A, **141**, 434 (1933) and **144**, 188 (1934).
[2] *Phys. Rev.*, **48**, 373 (1935).
[3] *Acta Phys. Chim. U.S.S.R.*, **2**, 273 (1935).
[4] *Phys. Z.*, **35**, 625 (1934).
[5] C. and M. Cuthbertson, *Proc. Roy. Soc.*, A., **84**, 13 (1911).

Bursts of Cosmic Radiation

BURSTS of cosmic radiation were observed in an ionisation vessel 14 cm. diameter and 27 cm. high, filled with carbon dioxide at 10 atmospheres pressure, and completely surrounded by 10 cm. of lead. The sizes of the bursts were estimated as ranging between 35 and 1,800 rays, while the average frequency was 0·88 per hour, with a maximum of four bursts occurring in any one hour.

The magnitude distribution of the bursts in a series of 2,640 observation hours could be represented by the expression

$$B = \frac{8{\cdot}3 \times 10^5}{R_2^{5/3} - R_1^{5/3}}$$

where B = number of bursts (per 2,640 hours) containing between R_1 and R_2 rays ($R_1 < R_2$).

This is of similar form to that suggested by C. G. and D. D. Montgomery to summarise the cascade theory of bursts[1].

The average rates of burst production for various barometric pressure groups were :

Barometer	Bursts/Hour
685–695 mm.	0·911 ± 0·019
695–700 mm.	0·840 ± 0·016
700–710 mm.	0·811 ± 0·019

The barometer effect thus amounts to approximately −0·75 per cent per mm., or about three times as great as that observed here for the bulk of the radiation.

The frequencies with which 0, 1, 2, 3, or 4 bursts respectively occurred per unit period of 57 minutes could be represented by the successive terms of the expansion of the binomial $(q+p)^n$. The values of q and p were found to depend upon the barometric pressure as shown in the following table :

Barometer	*n*	*q*	*p*	*P*	*N*
685–695 mm.	4	0·211	0·789	0·32	934
695–700 mm.	4	0·205	0·795	0·58	1251
700–710 mm.	4	0·197	0·803	0·32	904

P = the probability that the deviations between the observed and calculated values of the frequency could be caused by random sampling variations (χ^2-test).
N = total number of 57 minute periods of observation.

These results would be explained if the burst-producing radiation falling on the apparatus in the unit time of 57 minutes comprised only a few rays, namely, $n = 4$, each of which had a relatively high probability, q, of generating a burst. The assumption that the burst-producing radiation falling on the apparatus is composed of a large number of rays, each with a very small probability of producing a

burst, would require that the distribution of the above mentioned frequencies be of the Poisson rather than the binomial type, and this was not supported by the observations.

An increase of barometric pressure brings about a decrease of q with n remaining constant, and this is in line with Swann's hypothesis[2].

A. R. HOGG.

Commonwealth Solar Observatory,
Mount Stromlo, Canberra.
May 8.

[1] *Phys. Rev.*, **48**, 786 (1935).
[2] *Phys. Rev.*, **46**, 828 (1934).

Are Hymenoptera Tetraploid ?

A RECENT communication[1] has suggested that among Hymenoptera Symphyta males may be diploid, females tetraploid. It was further suggested that this characteristic might help to explain the phenomena of pre-conjugation as seen in *Apis* and *Cynips kollari*.

More light on the problem may be obtained by taking into consideration available genetic data. If the queen bee is a true tetraploid, one heterozygous for a given recessive factor might be designated *AAaa* and would be expected to produce impaternate diploid drones, an excessive number of which would show the dominant character (the exact ratio of dominants to recessives would rest upon the peculiarities of tetrad or octad formation). However, if the queen bee is diploid and heterozygous for a recessive factor, she would be designated *Aa* and would be expected to produce impaternate haploid drones, equal numbers of which would show the dominant or the recessive character.

Dzierzon, in 1854 (eleven years before Mendel's paper), stated that male offspring from a hybrid queen bee resembled one or the other parental race, the two types appearing in equal numbers. Newell[2] reports that hybrid queens resulting from crosses of yellow Italian and non-yellow Carniolan are themselves yellow and indistinguishable from the Italian parental stock, but "produce both Italian and Carniolan drones, produce them in equal numbers, and do not produce any other kind". A clearer demonstration of this genetic segregation is given by Michailoff[3]. A black-eyed bee, the mother of which was known to have produced white-eyed drones, herself produced a total of 811 white-eyed drones and 806 black-eyed. A black-eyed daughter of this queen, mated to a white-eyed drone, produced 191 white-eyed, 191 black-eyed females and 8 white-eyed, 11 black-eyed drones.

The same method of inheritance has been amply demonstrated by Whiting and his associates in the braconid, *Habrobracon*, for more than 100 mutant genes. Here females show 20 gonial chromosomes, males 10, and the possibility of a diploid–tetraploid condition is made improbable by the presence of one very small chromosome in the male, two in the female, as shown by Torvik-Greb[4] and verified by me. Moreover, recessive mutations in this species have so often been found in but a single male of a fraternity as to indicate that such mutations occurred shortly before maturation of the egg and were made visible by reason of the haploid condition of the offspring.

Also of interest in connexion with this problem is the fact that diploid males, which are occasionally produced in *Habrobracon* from fertilised eggs, show no synapsis of homologues during spermatogenesis and, behaving like haploid males, exhibit an abortive reduction division, resulting in diploid sperm.

Impaternate females likewise may appear in *Habrobracon*; these are diploid, and produce normal haploid sons. Recent cytological work indicates that these females come from unfertilised tetraploid eggs, and by inference, from tetraploid patches in the ovaries of their mothers. If the thelytokous mothers are heterozygous for any recessive factor, the impaternate daughters appear in the ratio of 3 dominants to 1 recessive[5], thus fitting the expectation for diploid progeny from tetraploid gonads.

Thus, although tetraploidy may be a characteristic of lower Hymenoptera, it is unlikely that this condition is normal among representative species of Apocrita. In all cases, genetic evidence would be desirable to back up the cytological findings, since by this means tetraploidy is readily demonstrable.

B. R. SPEICHER
(National Research Fellow in the Biological Sciences).

Columbia University,
New York.

[1] F. Greenshields, NATURE, **137**, 662 (1936).
[2] W. Newell, *Science*, **41**, 218 (1915).
[3] A. Michailoff, *Z. I. A. V.*, **59**, 190 (1931).
[4] M. Torvik-Greb, *Biol. Bull.*, **68**, 25 (1935).
[5] K. Speicher, *Biol. Bull.*, **67**, 277 (1934).

Bones of a Whale from the Wieringermeer, Zuider Zee

IN 1935, the hind part of a skull, two lower jaws and other bones of a juvenile whale were found in the soil of the Wieringermeer, a reclaimed part of the Zuider Zee. Dr. van Deinse and I came to the conclusion that these bones must have belonged to a young specimen of *Rhachianectes glaucus*. Close comparison of the bones with a skeleton of *R. glaucus* in the British Museum (Natural History) proved that our conclusion was a correct one. Mr. M. A. C. Hinton and Mr. F. C. Fraser are also convinced that our identification is right.

Nearly as interesting, however, is the fact that there are earlier records of this whale in Europe which seem to have been overlooked until now. As a matter of fact, the name *Rhachianectes glaucus* auct. must be changed to *Eschrichtius gibbosus* (Erxl.). Van Deinse and I propose to publish a detailed paper with full synonymy in the journal *Temminckia* in the beginning of 1937.

G. C. A. JUNGE.

Rijks Museum van
Natuurlijke Historie,
Leiden.

Immunological Detection of the *Y*-Chromosome in *Drosophila melanogaster*

THE general aim of this line of research is to detect hereditary substances in man and animals by means of immunological methods. We began with experiments on the *Y*-chromosome.

An intensely inbred stock of *Drosophila melanogaster* (Florida) was used. Rabbits were immunised, some by means of a gruel extract obtained from crushed male flies of this stock, and some by means of a similar extract obtained from the virgin females. Serum from the first group of rabbits was adsorbed

by means of a gruel obtained from crushed virgin females; serum from the second group was similarly adsorbed by males. In both sera the complement fixation reaction was made by using, as antigens, extracts of gruel of both males and females.

The results are presented in Table I:

TABLE I.*

Material for immunisation	Material for adsorption	Results with ♂♂ antigen (number of experiments)						Results with ♀♀ antigen (number of experiments)					
		++++	+++	++	+	±	−	++++	+++	++	+	±	−
♂♂	♀♀	15	34	3	0	0	0	0	1	13	12	8	18
♀♀	♂♂	0	7	11	12	4	8	2	7	10	11	4	8

* The number of plusses indicates the degree of positive result of the complement fixation reaction, that is, of the absence of hæmolysis.

As evident from this table, the results are not free from defects, chief of which seems to be insufficient adsorption. Apparently the individual characteristics of the rabbits are also of importance, particularly in view of a certain percentage of comparatively weak positive reactions in the series of experiments in which the immunisation was made by means of male extract and the adsorption by means of female gruel, the male extract being used as an antigen.

In view of the possibility that the positive results of this latter series might be considered as due to antibodies formed not against the *Y*-chromosome but against products specific for the male plasm, another series of experiments was undertaken. Serum, derived by immunisation by means of *Drosophila* male extract and adsorbed by means of females of the same stock was, in addition, adsorbed by means of females of the type *XXY* (double adsorption being necessary because the latter females, taken from another stock, evidently differed genotypically from the first line).

The results of this series of experiments are presented in Table II:

TABLE II.

Material for immunisation	Material for adsorption	Results with antigen (number of experiments)						Results with antigen (number of experiments)					
		++++	+++	++	+	±	−	++++	+++	++	+	±	−
♂♂	♀♀ *XX* and ♀♀ *XXY*	0	0	2	2	3	2	0	0	0	0	3	6

Further experiments are in progress. Details as to technique and a detailed report on the results will be communicated elsewhere.

S. G. LEVIT.
S. G. GINSBURG.
V. S. KALININ.
R. G. FEINBERG.

Department of Genetics and the Immuno-Biological Laboratory, Maxim Gorky Medico-Genetical Research Institute, Moscow. May 28.

Projection Method for Demonstration of Chromosomes *in situ*

THE demonstration of chromosome preparations has suffered from two serious difficulties in the past. First, the solid form of the object has to be reconstructed from images at different focuses, and it is impossible to be sure that an inexperienced observer has been able to do this. Secondly, chromosome behaviour in general has to be reconstructed from the observation of a great many cells, and their separate demonstration to one student, let alone a large number, is out of the question.

In order to overcome these difficulties (for the summer course of this Institution) we have experimented with the projection of images of the chromosomes on a screen, such as is commonly used for lower magnifications. We find that with a 10 ampère arc lamp, a strong condenser, and a water-ammonia heat-absorbing tank, a sufficient beam of light can be passed through the horizontal microscope (with a ×90 oil immersion apochromatic objective, N.A. 1·3, and a ×5 compensating eyepiece) to give a bright image magnified 5,000 diameters on a screen four feet in diameter and at a distance from the microscope of nine feet. The beam of light between the condenser and the microscope is enclosed to prevent glare. We find that a plain white screen is more satisfactory for our purposes than ground glass, opal glass, silvered or beaded screens. The microscope can be turned on a swivel, and the demonstration interrupted to show ordinary lantern slides.

This apparatus gives equally satisfactory results with well-differentiated hæmatoxylin and gentian-violet staining, with sections of root-tips and with smears of testes and pollen mother-cells. The form and internal structure of the chromosomes—their coiling and chiasmata—and the positions of such bodies as chromomeres and centromeres, 2000 A. in diameter, can be shown throughout the nucleus at focuses varying in depth 20–30 μ. They can be seen by ten or fifteen persons at once with our present experimental apparatus.

The use of this method should enable students to understand chromosomes in a real, and not merely a verbal sense. The apparatus can be made from everyday laboratory equipment and could, we believe, be installed with advantage wherever this subject is taught.

C. D. DARLINGTON.
H. C. OSTERSTOCK.

John Innes Horticultural Institution, London, S.W.19. June 30.

An Early Magdalenian 'Raclette' Industry in the Lower Thames Valley

IN 1930, Dr. A. Cheynier described a newly-discovered industry of Early Magdalenian age, located at Badegoule in the valley of the Vézère, characterised by a large number of end- and side-scrapers made on flakes and showing vertical edge-trimming. He termed these specimens "raclettes"[1]. Mr. A. S. Barnes, who has made a special study of the Upper Palæolithic phases of the Dordogne, refers to this culture in a paper on the Magdalenian period

of France, in which he records the close similarity between the edge-trimming on these 'raclettes' and on eoliths[2].

I have lately found, in Stone Court Valley, a 'floor' on the surface of the Lower Flood Plain gravel situated at the base of the Sunk Channel and overlain by an accumulation of alluvial beds and hill-wash. The Sunk Channel was cut in Late Pleistocene times through the gravels of the Upper Flood Plain, which are here overlain by some 10 feet of glacial material. The Stone Court Valley industry is similar to that described by Dr. Cheynier and consists of quantities of 'raclettes', a few carinated scrapers, points with a small notch on each side of the butt (lames à étranglement basilaire), hand-adzes, cores and plain flakes.

Mr. Barnes had already remarked that the retouches upon the Badegoule 'raclettes' recall on a small scale the high-angle chipping on eoliths; but one of the most interesting features of the Stone Court Valley find is the recrudescence among the other artefacts of specimens analogous, both in sizes and forms, to the Harrisonian eoliths of the Kent Plateau.

The results of this investigation, which I am conducting through the generosity of the trustees of the Percy Sladen Memorial Fund and the kind permission of the management of the Associated Portland Cement Manufacturers, will be published in detail upon its completion.

J. P. T. BURCHELL.

30 Southwick Street,
W.2.

[1] *Bull. Soc. Préhist. Française*, **27**, 483 (1930).
[2] *Proc. Prehist. Soc. E. Anglia*, **6**, pt. 4, 316.

Scientific Workers and War

THE article on "War, Science and Citizenship" in NATURE of May 9, and the letter on "Scientific Workers and War" published in the following week have expressed views no doubt widely held among readers of NATURE. Neither, however, gives any adequate suggestion as to how those scientific workers who hold such views can make them effective. Any steps depending on collective action through existing scientific organizations are obviously impracticable at the moment, for on the question of war, as on any other question of public policy, there are as wide differences of opinion among scientists as among the rest of the population. No existing organization of scientists, therefore, could at present make any pronouncement, apart from a purely platitudinous one, without serious loss of membership and of effectiveness in other directions.

On the other hand, an individual scientific worker who "first considers what ought to be done and then uses his influence to see that it is done" is acting simply as a private citizen and can do little to achieve that common action of scientists which is desired.

It seems to us, therefore, that the first requisite for any effective action along the lines indicated is the existence of an *ad hoc* organization of those scientific workers whose outlooks are sufficiently akin for an effective common policy to be possible. A policy arrived at by such an organization would not profess to be that of all scientific workers, but would doubtless carry great weight both among their colleagues and among many of the general public who are looking for a new lead. Furthermore, it might well result in existing scientific organizations, with their wider basis of membership, taking some kind of action. At the very least, it would call for a new standard of discussion among those who would oppose it.

A further difficulty must be faced. "To ally ourselves boldly with constructive political forces" as suggested, is not without its dangers. Opinions differ as to which political forces are the constructive ones. On matters where feelings run so high, any decisive action or expression of opinion is bound to cause offence in some quarters, and the offence is bound to be the greater the more original or effective such actions or opinions may be. Owing to their highly specialized training, many scientific workers have even more to fear than most people from the hostility of those who control their means of earning a livelihood. In these very questions to which we believe, with you, that professional scientists can make a distinctive contribution of real value to the community, we believe also that many of them—even in the remaining democratic countries—are kept silent by the certainty that an open expression of their opinions would seriously affect their careers or even bring them to a sudden end. This would certainly apply, for example, in many places to those holding some of the views mentioned in the Cambridge letter. It is with such considerations in mind that there has arisen among the staff and research workers of this University a group whose aim is to investigate the root causes of war and to find means of avoiding it. Isolated groups are, however, of little greater effect than isolated individuals, and we should welcome contacts with similar groups elsewhere in the hope of being able to arrive at a common programme.

E. BARROW, M.B.
J. DONEN, PH.D.
C. A. DU TOIT, PH.D.
B. GERSHILE, B.SC.
W. F. GRANT, B.SC.
W. S. S. LADELL, B.A.
L. A. J. LINCOLN, B.SC.
C. B. O. MOHR, PH.D.
C. J. MOLTENO, B.A.
E. O. PABST, M.SC.
G. F. PAPENFUSS, PH.D.
G. SACHS, M.B., F.R.C.S.
H. SANDON, PH.D.
N. SAPEIKA, B.A., M.B., CH.B.
J. G. TAYLOR, M.A.
E. M. THOMPSON, B.A.
J. WRIGHT, B.A., B.M., B.CH.
H. ZWARENSTEIN, PH.D.

University of Cape Town.
June 15.

Photo-Reduction of Fluorescent Substances by Ferrous Ions

DR. K. WEBER[1] has recently published a note on experiments which he connects with the results published previously by me[2]. There is, however, not much relation between his experiments and my investigations, as may be clear from the following remarks. Dr. Weber seems to be unaware of the fact that by the method which I described it is only possible to reduce fluorescent substances, and then only when they are in a suitable state to exhibit fluorescence. Indeed, his own failure to reduce dyestuffs such as neutral red and Nile blue, which he has reported recently[3], can be attributed mainly to the fact that these dyestuffs are non-fluorescent in aqueous solution.

It has been shown previously that, in principle, every fluorescent substance can be reduced by the influence of light in the presence of suitable reducing substances, for example, Fe^{++} ions, SO_3^{--} ions[4], HS^- ions[5], reversibly or irreversibly. Dyestuffs

can always be easily reduced when they are fluorescent in aqueous solution, and Dr. Weber did not fail to confirm this. The reason simply is that the photo-reduction is identical with the elementary process of quenching of fluorescence. The dyestuff molecule in the excited state (F^*) which possesses an unoccupied electronic level (due to the excitation of one electron to a higher level) can take up an electron from a reducing (quenching) substance (into this level) according to the process :

$$F^* + Fe^{++} \rightarrow F^- + Fe^{+++}; \quad F^- + H^+ \rightarrow FH$$
(reduced dyestuff).

In this way the excitation energy in effect increases the electron affinity of the dyestuff molecule (F). When there is no fluorescence, there are no excited dyestuff molecules of an appreciable life-time, and consequently no photo-reduction can take place.

The photo-reduction is not quite so simple in the case of chlorophyll and other fluorescent substances which give non-fluorescent aqueous solutions, and where it is necessary to use a suitable mixture of solvents (for example, aqueous methyl alcohol), in which the ferrous salt is sufficiently soluble and also the dyestuff (chlorophyll) is capable of fluorescence.

Further details are given in a paper[6] which has recently appeared, and an additional paper on the same subject will be published shortly.

JOSEPH WEISS.
Sir William Ramsay Laboratories of
Inorganic and Physical Chemistry,
University College,
London, W.C.1.

[1] K. Weber, NATURE, **137**, 870 (1936).
[2] J. Weiss, NATURE, **136**, 794 (1935).
[3] K. Weber, *Naturwiss.*, **23**, 486 (1935).
[4] J. Weiss and H. Fishgold, NATURE, **137**, 71 (1936).
[5] J. Weiss, *Naturwiss.*, **23**, 610 (1935).
[6] J. Weiss and H. Fishgold, *Z. phys. Chem.*, B, **32**, 135 (1936).

The Mysterious Number 137

THIS is stated in NATURE of May 23, p. 877, to be more accurately 137·2. Now 1371288 is the natural number similar to the mantissa of its logarithm. How will this fact interact with the formulæ of origin ?

FLINDERS PETRIE.
American School of Research,
Jerusalem.
June 1.

Points from Foregoing Letters

To explain the elastic properties of viscid fluid threads, Sir Joseph Larmor imagines their molecules to be shaped like dumb-bells, interacting by forces between their ends, so that when two rows lie in parallel there is a position of equilibrium when the ends are opposite each other, and an elastic reaction comes into play which allows of a large range of reversible extension.

Crystalline pepsin is inactivated at a rate inversely proportional to the fifth power of the hydrogen ion concentration, between pH 6·2 and 6·45. This behaviour, Dr. J. Steinhardt considers, suggests the presence of an unstable pepsin ion, formed by the dissociation of five acidic groups with dissociation constants near $1{\cdot}7 \times 10^{-7}$.

From the reaction shown by regenerated tails of tadpoles and pieces of *Euplanaria* with sodium nitroprusside, N. S. R. Maloeuf concludes that the nitroprusside colour test is specific for the oxido-reduction enzyme glutathione, when applied to normal living tissues and when ammonium hydroxide is used as the alkali. Heat must not be applied, since it liberates free —SH radicals from protein, which then give a colour with the nitroprusside and invalidate the test both for glutathione and cystein.

F. Bergel and A. R. Todd discuss the possible structural formulæ of aneurin (vitamin B_1) and its oxidation product, thiochrome. Certain synthetic compounds show a fluorescence similar to that of thiochrome, and their known structure supports the formula suggested by Makino and Imai, and modified by Williams.

The formation of a radioactive isotope of iron by irradiation of cobalt with neutrons is reported by Prof. E. B. Andersen. The new isotope is probably iron of mass 59, and shows an activity decaying with a period of nearly 72 hours.

Dr. H. S. W. Massey and R. A. Buckingham calculate the values of the van der Waals' interatomic constant from observations by Rosin and Rabi on the collision of rare gas atoms (helium, neon and argon) with alkali atoms, observed by the molecular ray method. The authors compare the values with those derived from the polarizabilities of the atoms, and conclude that the free path method will prove convenient for the determination of van der Waals' forces.

An investigation by A. R. Hogg of bursts of cosmic radiation of estimated size 35–1800 rays suggests that the rays responsible for producing these bursts occur relatively infrequently, but that each ray has a fairly high probability of producing a burst. This probability varies with the barometric pressure.

Instances are quoted by B. R. Speicher to show that hybrid queen bees produce equal numbers of impaternate drones with dominant and with recessive characters. Hence he concludes that the impaternate drones in bees and wasps (sub-order Apocrita) are 'haploid', that is, they have the basic number of chromosome number in their nuclei, and are not 'diploid' as recently suggested in the case of male impaternate saw-flies (sub-order Symphyta).

The formation, in rabbits' serum, of 'antibodies' specific for the Y-chromosome of the male fruit-fly, after injection of a gruel of the insects, is indicated by experiments carried out by Dr. S. G. Levit, S. G. Ginsburg, V. S. Kalinin and R. G. Feinberg. An antibody when formed in the serum of living animals after the injection of an 'antigen' (in this case, extract of fruit-flies) 'fixes' the 'complement', a ferment which, in conjunction with an 'amboceptor', hinders the break-up of red blood cells and of bacteria.

A simple arrangement for the direct projection on a screen of microscopic slides showing the internal structure of chromosomes is described by Dr. C. D. Darlington and H. C. Osterstock.

J. P. T. Burchell reports the finding, in Stone Court Valley, of a 'floor' containing stone implements, including 'raclettes', at the base of the Sunk Channel, cut in Late Pleistocene times. The artefacts show features analogous to those observed among the 'eoliths' (earliest stone implements of tertiary age).

Research Items

Antiquities of the Jumna Valley

AN investigation by Prof. B. Sahni of mounds on the outskirts of the city of Khokra Kot, where their structure has been revealed by ravines cut through by rains, has produced a large number of relics, old bricks, pottery, etc. (*Current Science*, May 1936). A well-defined dark layer exposed in the side of a cliff at three feet below the surface, yielded hundreds of black terra-cotta disks, afterwards identified as moulds for coins. These, as is shown by a Brahmi inscription, must be assigned to the Yaudhiyas and dated at about 100 B.C. Some were found afterwards still to contain coins. The coins are of bronze. On the obverse is a humped bull, looking to the right, with head obliquely pointing to the observer. In front of it is the conventional sign for a tree enclosed within a railing. On the reverse is an elephant, also pointing to the right, in various postures of walking or running, with trunk upraised. In some, the tail is bifurcated. Above is the Brahmi letter *ga* and the *triratna* or *nandipada* symbol. The matrices were either baked over a slow fire of paddy or wheat and barley, or they were packed in them, when the molten metal was poured in. They show impressions of the paddy straw, and charred grains adhere to them in the form of a carbonized crust. A terra-cotta model of a humped bull probably came from the same level. Other relics belong to a distinctly lower, and probably earlier, level. A glazed pot of white paste bears on its inside a clear impression of a finely woven cloth. In this was an ink-like substance, which analysis has shown to consist of carbon (lamp-black) with mineral substances. A shell bead is carved out of the columella of a large gastropod. It is suggested on the ground of the resemblances of these objects in style to antiquities from Mohenjo-daro and Harappa, that there may be in the Jumna valley a tradition of a connexion with the Indus valley civilization, which systematic investigation on this site might confirm.

Antithyrotropic Activity

THE injection of extracts of anterior pituitary causes hyperplasia of the epithelium of the thyroid gland and general symptoms of hyperthyroidism. The effect on the thyroid is not maintained for long, and the symptoms of hyperthyroidism disappear, in spite of the continuance of the injections. Collip and Anderson showed that this disappearance of the effects is due to the appearance of inhibitory antithyrotropic substances in the blood. Rowlands and Parkes (*Proc. Roy. Soc.*, B, **120**, 114; 1936) have studied the properties of this antihormone. Inhibition of the effect of thyrotropic extract on the weight of the thyroid of the immature guinea pig was used as a test of antithyrotropic activity, and a method of assay is described. Normal blood has no action. If thyrotropic extract is injected daily into rabbits, antithyrotropic activity begins to appear after four weeks and reaches a maximum in ten weeks. The results described are in complete agreement with the antihormone theory of Collip and his co-workers. It would be difficult to over-estimate the biological importance of this theory.

Northern Phytoplankton and its Production

DR. E. STUMANN NIELSEN has investigated the general plankton production conditions in the Faroe, Icelandic and East Greenlandic waters proper as well as dealing, although in less detail, with the whole of the northern region of the Gulf Stream and the bordering colder regions (*Meddelelser fra Kommissionen for Danmarks Fiskeri og Havundersøgelser*. Serie: Plankton. 3, No. 1; 1935). He gives the results during 1932–34, made chiefly with the Danish research ship *Dana*. All the plankton work was done in close co-operation with the hydrographic observations, and in 1934 the transparency of the water was also registered. The phytoplankton production is one of the most important links in the chain of factors leading to the production of great fish populations. On it depend the fisheries of all our seas either directly or indirectly. The conditions of production are of a very diverse character in the different seas around Iceland and the Faroe Islands, the factors that are of importance do not act in the same way everywhere, and it is only when they act together as a harmonious whole that the possibilities of production are optimal. Light and the quantity of nutritive salts are of supreme importance in restricting the plankton production in northern waters, but there depend many other factors which partly work into one another, such as stabilisation of the surface layers and the transparency of the water (including amount of detritus present); temperature and salinity having as a rule only a regulating effect. More exact studies into vertical movements of the volumes of water in the sea are advocated and also systematic investigation regarding the transparency of the sea throughout the year, together with detailed inquiries into the relation between the areas with large production of phytoplankton and those with great fish populations.

Researches on the Sucking Lice

THERE has recently come to hand Part 8 of "Contributions towards a Monograph of the Sucking Lice" by Dr. G. F. Ferris, and published by the Stanford University Press, California. This fascicle forms No. 8 of vol. 2, Stanford University Publications, Biological Series, 1935, and completes the monograph concerned. It deals especially with the lice of man and certain other primates. The author arrives at the conclusion that the genus *Pediculus* contains but three species. The question, so often debated, as to what constitutes a species is of particular interest in connexion with this genus, and the author defines his attitude as regards the problem as definitely as possible. Of the three species recognized, *P. humanus* L. is adopted as the name for the whole assemblage of Pediculi found on the races of man. It seems clear that it can also establish itself upon other primates which have been in contact with man. The validity of the author's conclusions remains to be tested by experimental work upon the various forms that are known to occur. The second species, *P. mjöbergi* Ferris, infests monkeys of the family Cebidæ, and *P. schäffi* Fahrenholz occurs on the chimpanzee. Of the genus *Phthirus*, in addition to *P. pubis* (L.), the existence of a second species, *P. gorillæ* Ewing,

is doubtful, and adults are, as yet, undescribed. The fascicle concludes with an appendix relating to Anoplura dealt with in the earlier parts of the monograph, and an index.

Inhibitors of Tobacco Mosaic Virus

SEVERAL viruses produce local lesions upon the inoculated leaves of certain host plants, and this capacity has been used to test the effects of various inhibiting substances. It has not, however, always been possible to determine whether the inhibitor was acting upon the virus or the host, but Dr. J. Caldwell has evolved an interesting technique to separate these effects ("Factors affecting the Formation of Local Lesions by Tobacco Mosaic Virus", *Proc. Roy. Soc.*, B, **119**, 493–507, March 1936). The earlier part of the paper shows that if the inhibitor acts upon the virus, its effect should increase with decreasing virus concentration, and the reverse effect would indicate inhibitory action upon the host. Experiments with normal sera of horse and rabbit, with trypsin, and with silver nitrate, indicate that all these inhibitors act upon the virus. The mode of action is not yet quite clear, but should form a fascinating subject for future study.

Unity of Force and Matter

THE Masaryk Academy of Work has just published a thesis by Dr. J. Bašta entitled, "L'unité de la force et l'unité de la matière dans la conception physique uniforme du monde", in which the author sets out to show that, mathematically and physically, all matter is composed of what he terms 'proto-atoms'. Experiments are cited to indicate the possibility of reducing the various causes of pressure and acceleration, for example, cohesion, adhesion, chemical affinity, adsorption, vapour pressure, osmotic pressure, gravity, magnetic and electrical attraction and repulsion, etc., to a single force. This force is the cause of strain in static states and of acceleration under dynamic conditions. It is supposed that this simple force is the attraction of the smallest elementary particles of matter (proto-atoms). The range of action of these bodies is limited by the amplitude of their vibrations. The attraction is transmitted only by contact of one particle with its neighbour. All action at a distance is excluded. The primary sources of this elementary attraction are the proto-atoms. Atoms of the chemical elements and also the ultimate particles of cosmic ether represent different complexes of these ultimately simple proto-atoms which, it is postulated, are only able to exercise an influence on primary matter in their own material system or on other systems by their residual lines of force.

Oceanography and Meteorology of China Seas

Koninklijk Nederlandsch Meteorologisch Institut publication No. 115, entitled "Oceanographic and Meteorological Observations in the China Seas and in the Western part of the North Pacific Ocean", is a large atlas in which are set out cartographically the extensive observations collected during many years by Dutch and other ships in East Asiatic waters in a similar form to that of the atlases of the Indian Ocean (Publication No. 104) and of the Atlantic Ocean (No. 110). The text is in Dutch, with an English translation, but the names on the maps are in English only. The work is in accordance with the recommendations of the Fourth Pacific Science Congress of 1929 at Batavia for active international co-operation to develop the practical and scientific aspects of oceanography and meteorology, and for this reason more observations from ships of other nationalities—especially those of Great Britain, the United States, France and Germany—have been used than in the case of the similar earlier Dutch publications. The result is an impressive mass of marine statistics set out in great detail and with admirable clearness, on charts roughly 18 in. × 18 in. It is a bulky publication, which when open occupies a space of 3 feet 6 inches by nearly 2 feet, but by adopting a large size for the charts excessively small lettering has been avoided. For the General Current Circulation 'one degree squares' are used. Each of these contains an arrow showing the average observed resultant current, and figures alongside giving the average speed in nautical miles per day and the number of observations, while the stability of the circulation is shown by the length and thickness of the arrow. Each month is dealt with separately; the information just described is shown on the left hand page at an opening, while on the right hand page the current roses for the same month are given on 'squares' of rather larger size—generally 5° of longitude by 3° of latitude. These roses follow a well-known standard form, the percentage frequency of a given direction of current being shown by a suitable length of line on the scale 1 mm. = 2 per cent, and various ranges of speed are represented by various thicknesses and shadings of line. On the same system of 'squares' the monthly data for the ordinary meteorological elements, wind, fog, precipitation, pressure, air and sea surface temperature are set out, and also the tracks of the more important temperate depressions (here designated continental depressions) and typhoons.

Iron Wire and Nerves

IN the study of complex problems, the construction of a simplified model may serve as an aid to comprehension. It is now eighteen years since R. S. Lillie first directed attention to the similarity between the properties of iron wire immersed in nitric acid and those of living nerves. During these years the phenomenon has been more closely studied, and many more points of similarity have been discovered. A review of the present situation has recently been published (*Biol. Rev.*, **11**, 181; 1936). When the iron wire is placed in nitric acid it is quickly covered with a film of oxide which protects it and makes it 'passive'. If this film is broken, the damaged area becomes anodal and local currents flow which break down a new area of the film, and this in turn 'stimulates' another area and an 'impulse' passes along the wire. When the impulse has passed, the damage is quickly repaired. The model resembles nerve in the fact that it can be stimulated by electric currents, and the laws governing the conditions necessary for excitation are similar. The 'chronaxie' of a certain model was about the same as that of heart muscle. After stimulation, the model shows an absolute refractory period followed by a relative refractory period. The temperature coefficients of the two processes are about the same. If the wire is enclosed in a tube the velocity of transmission is diminished. This is compared with the slow transmission in small nerve fibres. If a wire is enclosed in a series of short tubes, the impulse can jump straight from one node to the next and the impulse passes quicker than normally. This is compared with the nodes on the myelin sheath of certain quickly-conducting nerves. Under certain conditions, models may show rhythmical activity.

Centenary Celebrations of the University of London

THE hundredth anniversary of the University of London was celebrated during the week June 29–July 3 with a full programme of functions. The proceedings were inaugurated at an afternoon reception on Monday, June 29, in the Great Hall of the University at South Kensington. Here nearly two hundred representatives of universities and learned societies in every corner of the globe assembled to present addresses of congratulation and goodwill. The Chancellor, Lord Athlone, in welcoming the delegates, said that this great convention was a healthy reminder that learning recognized no national frontiers, that the whole band of great teachers, the whole band of eager students, were truly citizens of the wide world, and their influence for good was incalculable and illimitable. Honorary degrees were conferred on the following distinguished men, who were presented by the Public Orator: The Archbishop of Westminster, Dr. J. W. Mackail, Sir Charles Peers, Prof. G. M. Trevelyan, Mr. H. G. Wells, Senor Don Ramon Perez de Ayala (Doctors of Literature); Mr. S. A. Courtauld, Mr. P. M. Evans, Sir Joseph Larmor, Sir George Newman, Lord Snell, Lord Wright (Doctors of Law); Dr. R. Vaughan Williams (Doctor of Music); and Sir William Bragg and Prof. Max Planck (Doctors of Science). Degrees were also conferred *in absentia* on Dr. Emile Legouis (Doctor of Literature); Mr. Justice Cardozo (Doctor of Laws); Prof. Albert Einstein and Prof. Johan Hjort (Doctors of Science).

In the evening of the same day, a dinner was held at Grosvenor House. The Chancellor, who presided, read a message from His Majesty the King, Visitor of the University, conveying his sincere congratulations to the University on the occasion of its centenary, and alluding to the progress of the new buildings at Bloomsbury as marking the beginning of a new era as well as a new century in the life of the University. Sir Thomas Inskip, in proposing the toast of "The University", said that within the space of a hundred years the University had attained such a position that it was able in everything but antiquity and beauty of situation to challenge the supremacy of the two great Universities of Oxford and Cambridge, and had fully justified the foresight of those who founded it. Time would make it as venerable as its rivals, and the generosity of public and private benefactors would soon enable the University to have buildings as beautiful and as well placed as any in the land.

The Chancellor, in reply, commented on the happy spirit of co-operation and goodwill which to-day existed between the learned institutions of the world. The exchange of teachers and students and ideas was of the utmost significance, and the Universities of the world might well claim that they were making a contribution of high value and importance in the promotion of peace and understanding. He stressed also the importance of unity, though not necessarily uniformity, within the University itself, and remarked on the analogy which the constitution of the University, with its federation of semi-autonomous Schools, presented to the British Empire. The one was no less real than the other. "The respective spheres of University and College", he said, "are clearly defined in black and white but no written statute is of any avail apart from that spirit of goodwill, that desire to pull together, which is characteristic of London University". The toast of "The Guests" was proposed by the Vice-Chancellor, Mr. H. L. Eason, who said: "This great gathering is a token that the ideal that should underlie all Universities is not forgotten, namely, that academic learning should have no boundaries of space, nationality, religion or politics. Without this spirit, learning would have perished in the Middle Ages, and there never was a period in the world's history when the maintenance of complete academic freedom of thought was more urgently needed than to-day". Prof. Louis Cazamian, of the University of Paris, Mr. G. H. Wilson, vice-chancellor of the University of Cambridge, Prof. L. P. Eisenhart, of Princeton University and Sir James Barrett, Chancellor of the University of Melbourne, responded, and congratulated the University on the distinguished record of its first hundred years.

Tuesday, June 30, was devoted mainly to functions at the various Colleges, while in the evening the Worshipful Company of Drapers, old and generous friends of the University, gave a ball at the Drapers' Hall.

On Wednesday, July 1, the University's friendly relations with the City of London were once more demonstrated and reaffirmed. To the special service of thanksgiving at St. Paul's Cathedral came a vast congregation of members and friends of the University. The citizens of London gazed upon a striking and colourful scene as the processions in academic costume wound up Ludgate Hill. First the professors and readers entered the Cathedral. Then came the Lord Mayor, the Sheriffs and Corporation; and finally the Chancellor's procession, consisting of the delegates from sister universities and learned bodies, honorary graduates, the Court and Senate and the Chancellor. The service, which was broadcast, was impressive in its simplicity. The Archbishop of Canterbury, in an eloquent sermon, paid tribute to the high ideal which had animated the founders of the University one hundred years ago and which was still incorporated in the Statutes, "to hold forth to all classes and denominations without any distinction whatsoever an encouragement for pursuing a regular and liberal course of education". This ideal was now accepted as a commonplace of public policy, but in those days great courage was needed to assert it. The University had been a pioneer of the movement which had given universities to most of our large cities, and though unlike its younger sisters it had not been able, by reason of the vastness of London, to make such an impact on the life of the city, the presence of an institution which not only prepared students for profitable and useful careers but which also fostered the things of the mind and the spirit, the pursuit of knowledge and truth for their own sake, was of incalculable benefit to London. Throughout its development the University had lacked one thing—a body, so to speak, in which its soul might find a fitting home. This was now at last to be remedied, and at Bloomsbury there was arising a great building wherein for the first time the length

and breadth and depth and height of the ideals for which the University stood would find a visible, noble, enduring embodiment and witness—a reminder to London that it had its own University in its midst.

After the service, the Lord Mayor and Corporation gave a luncheon in Guildhall. Lord Halifax, speaking as Chancellor of the University of Oxford, said that one of the greatest achievements of the nineteenth century was the assertion of the principle of an extended university education. This had inevitably given rise to a tendency to consider that the progress of the human race was automatic, provided that education could be sufficiently widely diffused. It was, however, being increasingly realized in these days that much knowledge might be a dangerous and destructive thing unless it was directed by something greater than itself. One had only to think of man's discovery of aeroplanes, of chemical laws and products and even of the internal combustion engine, to realize how dangerous they could be, unless guided and inspired by that which was greater than themselves—wisdom. Civilization must depend on training men to become masters rather than victims of their own inventions. No greater aim could be set before a university, and they could wish no better thing for London's university than that for the next critical century of its history it might continue to inculcate those principles to which in the past hundred years it had been so faithful.

The Chancellor, in reply, said that the first and perhaps the most difficult stage of the University's history was now past, and they might recall, with justifiable elation, the apprehension and dismay with which at the outset the project was greeted. All that the University had striven and was striving for would be consolidated in its new home, and there the University would pursue its course, going quietly and steadily forward; and when the next hundred years had passed there would be found the same spirit, the same high ideals, which animated the University of London to-day.

Lord Macmillan, chairman of the University Court, who proposed the toast of "The Lord Mayor and Corporation", referred to the friendly relationship between 'town and gown' which had always existed in London, and recalled episodes separated in time by more than a hundred years in which the City Corporation had shown its great interest in the cause of university education in London. The University, like the City, was engaged in commerce —not of commodities but of ideas—a commerce which knew no quotas, no embargoes, but where universal free trade existed. The best means for bringing about in the distraught world a renewal of friendship, mutual confidence and well-being, was by the promotion of those common bonds which scholarship and learning alone could furnish. The Lord Mayor, responding, said that the Corporation of London had always identified itself with the cause of education and had ever striven for that freedom of thought and action, in the wise and appreciative use of which the finest achievements of the human mind had become available for the benefit of mankind.

In the evening, His Majesty's Government held a reception at Lancaster House, where the guests were received by the Lord President of the Council and Miss MacDonald.

The proceedings were brought to a conclusion on Friday, July 3, with a brilliant reception given by the London County Council, the hospitality of which once more bore witness to the generosity and goodwill which characterizes its relationship with the University.

Throughout the week, hospitality was freely extended to the delegates by the Colleges and Schools of the University in the form of luncheons, garden parties, dinners and evening receptions, and all offered facilities for the visitors to see something of their work and activities.

A memorable occasion was thus worthily celebrated. The University, on the threshold of a new phase of its existence, may well be satisfied with the demonstrations of loyalty and friendship which the completion of its first hundred years has evoked, not only from those within its bounds but also from all those far and near who come into contact with its widespread activities.

The National Physical Laboratory

ANNUAL INSPECTION

ON July 1, the annual inspection of the work in progress at the National Physical Laboratory was made by the General Board and also by a large number of visitors representative of scientific, academic and commercial institutions throughout the country. The visitors were received in the High Voltage Laboratory by Sir William Bragg, president of the Royal Society and chairman of the Board, the Right Hon. Lord Rayleigh, chairman of the Executive Committee, and Sir Frank Smith, director of the Laboratory. Some three hundred exhibits illustrating the work performed in the eight departments of the Laboratory were on view; a brief summary of some of the more recent or interesting developments is given below.

In the Physics Department, the analogous problems of the transfer of heat from metal pipes and moisture from wet surfaces to a stream of air flowing over them have been investigated, and similar laws are found to hold for the two processes. The effect of inducing turbulence in the air-stream has also been studied. A simple falling plug method for determining the viscosities of liquid refrigerants has been devised. The apparatus is calibrated with liquids of known viscosity, and may easily be adapted to work under pressure and at low temperatures. The investigation of the changes of length of hygroscopic materials with humidity has continued and a demonstration was given of the application of such a material—gold beaters' skin—to the maintenance

of constant humidity in a chamber. The thermal conductivity of a variety of materials used in building and refrigerating practice has been measured with the cold face at normal or low temperature. The thermal conductivity of metals at high temperatures is obtained by connecting the specimen in series with a rod of iron of known conductivity and measuring the temperature gradient through the latter.

Work on the application of X-ray methods to industrial problems has continued in the Radiology Division with the object of correlating the physical, electrical and magnetic properties of materials with their lattice structure. In this connexion, the effect of fatigue stresses on the structure of mild steel specimens has received a considerable amount of attention recently. For the checking of 'air-wall' ionization chambers designed to measure radium dosage in röntgen units, a 'free-air' ionization chamber approximately 10 ft. square in cross-section has been constructed and was exhibited. The experiments with this have shown that the results obtained with an 'air-wall' ionization chamber of suitable wall thickness are quite trustworthy. A single-stage electrometer-valve amplifier has been used for the rapid measurement of radium by the γ-ray method. The results obtained with it agree satisfactorily with those given by the standard apparatus.

A considerable amount of test work on sound-absorbing and other building materials has been carried out in the Acoustics Laboratory, and routine testing of the transmission of sound through walls and floors was demonstrated. The methods for the calibration of microphones in absolute measure have recently been extended, and standard instruments were shown, the calibration of which was known over the whole frequency range from 10 to 10,000 cycles per second. The standardizing apparatus and lagged chamber with which these calibrations were obtained were also on view.

In the accurate calibration of thermocouples it is necessary to maintain the furnace at a constant temperature for relatively long periods. A high degree of thermostatic control has been obtained by making the platinum heating element one arm of a Wheatstone's bridge which is arranged to be balanced at any desired resistance—and hence temperature—of this element. In this way it has been found possible to control the temperature at any point in a furnace to 0·01° C. at temperatures in the region of 1,000° C. A very close approach to a true black-body radiator has been realized by introducing a hollow nickel cylinder into a tubular furnace thermostatically controlled as above, and compensating for the axial temperature gradient in the nickel by additional heating elements at its ends.

In modern optical instruments, considerable attention has been paid to the attainment of greater light efficiency, and field brightness tests have assumed greater importance than hitherto. Photo-electric methods have now replaced the ocular methods previously used, and greater precision and rapidity in carrying out these tests have resulted.

The high precision obtained in frequency measurement in the Electrical Standards Division of the Electricity Department by the use of quartz ring and tuning fork oscillators has now been utilized so that the whole of the audio frequency range may be covered in small steps by frequencies which are known to within a few parts in 10^8. An oscillator of multivibrator type is tuned approximately to the frequency required, which must be a submultiple of 1,000, 20,000, 40,000 or 80,000, and is then held in step by an output of one of the above frequencies obtained from the primary standard. In this Division also the use of platinum as a material suitable for standard resistance coils has been investigated. The high temperature coefficient of this material necessitates a very accurate control of the temperature at which the coils are measured, but nevertheless with suitable precautions it has been found that results consistent to about 1 part in a million may be obtained. A very useful method of measuring dielectric properties at very high frequencies has recently been developed. It depends essentially upon the measurement of the width of the resonance curve of a tuned circuit which contains the specimen under test. Measurements over the frequency range 10^4–10^8 cycles per second have been made by this method.

The stroboscope method of frequency control in the Electrotechnics Division has been materially improved during the past year by the elimination of contacts on the standard tuning fork. A valve-maintained fork is now used, the output coil of which is connected to the grid of a thyratron. By this means a charged condenser is made to discharge through the thyratron and the primary of an induction coil once per fork cycle. Special neon lamps connected in the secondary circuit of the induction coil illuminate the stroboscope disc.

In the High Voltage Laboratory researches on the effect of transient voltages on insulation in general are proceeding, and the technique of high-speed cathode ray oscillography has been further improved. The testing of a lightning arrester connected across the end of the new overhead transmission line was demonstrated.

During the past year a new Photometry Building has been erected to accommodate the photometric work and the illumination research of the Electricity Department. In the design and equipment of the building special attention has been paid to the particular requirements of this work. In addition to rooms for routine photometry, preparation and maintenance of substandards, and experimental research, the building contains a wide room 145 feet long for work on all types of projection apparatus. By opening a roller shutter at one end of this room, the range over which this work is carried out can be extended when necessary to nearly 800 feet. Various problems in connexion with glare and its after-effects are being examined in the Division. To enable the results to be applied in practice, a knowledge is required of the rate of expansion of the natural eye-pupil during recovery from exposure to a high brightness. The subject is most conveniently studied by taking a cinematograph film of the eye during recovery, using for this purpose infra-red radiation, which does not affect the phenomenon under investigation.

A photo-electric daylight factor meter has been developed in the Division. The instrument consists in essence of two rectifier photo-cells in circuit with a microammeter. One is placed on the window-sill and receives light from a definite small solid angle of the sky. The other, which is compensated for light obliquity, is placed at the point where the daylight factor is to be measured. There is a variable resistance in parallel with the photo-cell on the window-sill. The mode of operation is to adjust this resistance until the microammeter reading remains the same, when it is connected in succession to the

photo-cell resistance combination and to the photo-cell in the room. By means of a calibration curve, the daylight factor is given directly by the values of the resistance.

A photo-electric spectrophotometer, incorporating a thin film potassium photo-cell, has been designed for the rapid determination of the spectral transmission of coloured filters. A method has been devised for checking the linearity of the photo-cell characteristics at any desired wave-length.

In the Radio Department advantage has been taken of the fact that magnetron valves used for generating very short waves may, by the application of sufficiently intense magnetic fields, be made to operate at frequencies at which direct measurements of their input impedance are possible. In this way it has been found that electronic oscillations occur in such a valve near the condition of resonance. A portable direction-finding receiver for operation on wave-lengths between 8 metres and 10 metres was exhibited. The receiving loop is screened inside a solid copper tube and a push-pull input connexion to the first stage of the receiver is used to maintain electrical symmetry. A direct-reading frequency-measuring equipment has recently been constructed in this Department whereby the frequency of any radio oscillations between 1 and 70 megacycles may quickly be determined with an accuracy of 1 part in a million.

With the object of achieving greater stability in the frequency of transmitters, the work on design of condensers and inductances of low temperature coefficient of reactance has continued and a selection of such components was shown. An automatic monitoring system for the control of the frequency of a transmitter by a stabilized master-oscillator has been developed for use with the above. A novel exhibit in this Department was the outcome of co-operation with the Forest Products Research Laboratory. The apparatus was designed to detect the presence of destructive insects in timber, and consists of a sound-proof chest, a sensitive microphone and a high-gain amplifier. The microphone is placed in contact with the specimen of timber in the inner box of the chest, and any faint sounds created by destructive insect activity are received by the microphone and amplified to audible level.

Among the exhibits in the Metrology Department mention should be made of the interference apparatus for precise measurements of the refractive index of air. The method consists in the observation of Brewster's fringes in monochromatic light produced by two tubular invar étalons, one being permanently evacuated and the other containing dry air under the required conditions of test. The latter étalon is then evacuated, and from the change in the fringe system the value of μ-1 may be calculated. Measurements on photographic records of the fringe patterns made with the aid of a microphotometer enable a precision of 0·01 of a fringe interval to be obtained.

The new type of comparator for block gauges is now completed, and offers increased facilities for measuring the larger sizes of gauges to an accuracy of a millionth of an inch. The new pitch measuring machine for tapered screw gauges has also been completed. In addition to these exhibits, a large variety of machines used in the routine testing of engineers' gauges of every description was shown. An automatic pipette for the delivery of small and accurately known quantities of mercury was demonstrated in the Glass Testing Building.

Research in the Engineering Department on the structural changes associated with static and fatigue fracture of metals has been continued throughout the year: the X-ray method of attacking this problem has proved very valuable, since the primary cause of failure is associated with changes of a sub-microscopic nature in the crystalline structure. In connexion with researches in this Department on the wind pressures around buildings, the experiments on isolated models have now been extended so as to determine the effect of neighbouring structures. In order to obtain results which may be applied to structures in built-up areas, a model of the buildings lying in an area about half a mile square immediately to the north of the Thames Embankment has been constructed. This can be accommodated in the 14-ft. wind tunnel, and the actual test model is placed near the middle of this built-up area. Other aerodynamical problems under investigation are the characteristics of air streams loaded with granular matter, and the effect of roughness of pipes on air flow through them.

Wheel impact measurements have been continued throughout the year on a six-wheeled lorry under various types of loading, tyres and road surfaces. The equipment for carrying out similar tests on a private car has just been completed, and an economy in size and power consumption of the recording apparatus has been achieved. Typical records obtained in the course of this investigation were exhibited.

In the section devoted to lubrication research, refined measurements have been made of the change of shape at the crown of the bush when a plain bearing is run to seizure. The beneficial effects of rotation in both directions during the running-in of a bearing have also been demonstrated. The influence of temperature and rate of oscillation on the friction developed in an oscillating bearing is also under investigation, and the characteristics of various oils, in particular the extreme pressure lubricants recently developed, have been studied with the aid of two new machines in which the bearing surfaces are well defined. An investigation into the behaviour of bolted pipe flanges under high-pressure high-temperature steam is being carried out with the view of obtaining leak-proof joints in pipes operating under these conditions.

Among the researches in progress in the Metallurgy Department, that dealing with the alloys of magnesium promises to have important commercial results on account of the lightness combined with strength of some of these alloys. The technique of working such alloys is also being developed. Work on alloy steels for use at high temperatures is being continued, and corrosion tests on specimens exposed to high-pressure steam have been carried out. A method of determining thermal curves at high temperatures *in vacuo* was demonstrated in the high-frequency furnace room. The accessory apparatus made and used in the routine work of this Department was exemplified by a comprehensive display of refractory materials, including articles of sintered alumina and thoria for use at very high temperatures. A potentiometer was also demonstrated by means of which thermal curves of metals and alloys can be plotted automatically on a chronograph. The potentiometer dials are operated by an electric motor which is controlled, through a relay and photo-electric cells, by the light reflected from the galvanometer mirror.

An interesting exhibit in the Aerodynamics Department was an instructional film produced in this Department to show the flow of air around various models. The flow is made visible by producing a succession of hot spots in the air stream by means of spark discharges and observing them by the *Schlieren* method of illumination. The transitory and steady state conditions following the initiation of the air stream were illustrated with several models. By using a high-speed camera, it is possible by this method to analyze changes in the motion which are far too rapid to be seen by the eye.

The high speeds at which modern aircraft now operate have called for aerodynamical surfaces and shapes which offer as little drag as possible. This is not always compatible with the attainment of the requisite mechanical strength in the part concerned—notably in the case of monoplane wings, which need to be thickened at the root in order to be sufficiently strong. Tests have been carried out on such wings in order to determine the best conditions of compromise between drag and strength. The drag on aerofoils at high speeds where compressibility of the air becomes of importance has been measured directly on a balance and indirectly by measurements of the loss of momentum of the air stream at various points behind the model. The latter method is valuable since it may be applied to an actual machine in flight and hence allow of the separation of the scale effect and the compressibility effect in going from the model to the full-scale machine.

At the other end of the scale, the stability of aircraft at low speeds is receiving considerable attention, and the effect of slots and flaps and other landing devices is being studied. A demonstration was given of a model being tested in this way. The model is given a slow rolling motion, and measurements are made to determine whether such motion tends to be checked or accentuated. In order to verify a simple empirical formula which has recently been suggested for predicting flutter speed from the resonance frequency of a wing in still air, various types of wing have been under test in order to determine to what extent a numerical factor in the formula varies with the types of wing generally used.

In the Yarrow Tank of the William Froude Laboratory, experiments were being conducted on a self-propelled model cargo vessel, the rolling of which was measured continuously from an initial angle of heel. The tests are being made to differentiate between various types of keels and their position on the hull, and also to throw light on the effect of factors of design upon the extinction of rolling.

The effect of rate of revolution of twin-screw propellers on their propulsive efficiency has recently been studied. The results show that for any given pair of screws, there is an optimum speed of rotation at which this efficiency is a maximum. In addition to these exhibits, a variety of instruments for making tests on models and full-sized ships was exhibited.

South-Eastern Union of Scientific Societies

ANNUAL CONGRESS AT OXFORD

THE South-Eastern Union of Scientific Societies met for the first time in its history at Oxford on the occasion of its forty-first annual congress on June 30–July 4. Prof. G. D. Hale Carpenter, Hope professor of zoology at the University, occupied the presidential chair. The congress was held under the patronage of the Vice-Chancellor of Oxford, A. D. Lindsay, Master of Balliol College, and the Pro-Vice-Chancellor, the Warden of Wadham, welcomed the members at Rhodes House at its first meeting.

Prof. Hale Carpenter chose as the subject of his address "Charles Darwin and Entomology". The subject was, he said, of peculiar interest at Oxford, for his predecessor in the Hope professorship, Sir Edward Poulton, had made Oxford the centre for the study of the Darwin-Wallace theory of natural selection, as applied to the coloration and evolution of insects. This could only be explained on that theory. Sometimes it pays an insect to change its appearance according to whether it appears in a dry or a wet season. Poulton pointed out that a dry season is one of scarcity of food, and certain butterflies then remain inconspicuous, and of skulking habits, whereas in a wet season they are quite conspicuously coloured, and they can afford to allow some of the species to be eaten by reason of their numbers. Prof. Hale Carpenter referred to a species (*Charaxes zoolina*) from Africa which is conspicuous in the wet season, but in the dry season assumes a dead-leaf brown, and deliberately hides itself amongst clusters of dead leaves. Such cases afford support to Darwin's theory. It was customary for early entomologists to assume that coloration of the kind was due to the foresight of a beneficent Creator, and many statements were quoted from their writings to show this point of view, although Erasmus Darwin had some very pertinent remarks suggesting that variations in colours had some greater meaning than had then been discovered.

The clarification of the whole subject came when Darwin formulated his theory of natural selection and the preservation of favoured races in the struggle for life. This added zest to the study of entomology and revolutionized the older views. In spite of the rejection of the theory by some biologists nowadays, Prof. Hale Carpenter remarked, "No explanation has yet been put forward which covers the facts of the coloration of insects so well as does the theory of natural selection". Bates first gave a rational explanation of what he called mimetic analogy, now usually termed mimicry. Certain insects will mimic the outward form of others that are distasteful, and the enemy will avoid them, although not really distasteful. At the root of the matter lies the question of memory, and the assumption is that some of their enemies have recollections of distastefulness. "A variation which assumed a mimetic form has a better chance of surviving to reproduce its like by the laws of heredity, and an initial slight resemblance may be perfected into astonishingly detailed mimicry".

In his address to the Botanical Section, Mr. A. J. Wilmott spoke on the "Endemic Flora of Britain". He controverted the generally-accepted theory that the flora of Britain was exterminated in the Ice Age some ten thousand years ago. He held that at its height there were probably many nunataks where plants took refuge, apart from those parts of southern England which were never in their entirety and at one and the same time covered by ice. In addition, there were four interglacial periods during which there was amelioration of climate, when plants could obtain any foothold that they had lost during the severe periods of glaciation. Considerable migration from place to place was evident, during which there was possibly an "orgy of variation". It was mentioned that ten years' work on the compilation of a new flora of Sussex, commenced at the Hastings Congress in 1927, had now brought publication within view, and subscribers and contributions towards publication were needed.

In the Zoological Section, Lord Mansfield gave an address on "Bird-Ringing and Bird Migration". He said that a very small proportion of rings is ever returned, and an endeavour is to be made to reach the peasantry of various lands who never read pamphlets or newspapers, and thus know nothing of the value of the rings that they collect. Experiments he had made have shown that it is not only the desire to avoid cold climates that gives the impetus to migration. A canary and other birds when supplied with food have been seen feeding in the snow in Canada. Birds kept in an aviary have been found to wake up at night, whenever an electric light was turned on, and feed eagerly, birds' digestions being of a rapid nature. Food is what migrants have in view rather than the avoidance of cold. Reference was made to the endeavour now being carried out to induce the breeding of storks in England, and a report promised for next year's Congress. Mr. E. M. Nicholson spoke on the progress of the British Trust for Ornithology.

Of considerable interest and value is the report of the Insect Immigration Committee, conducted under the energetic guidance of Capt. T. Dannreuther. Observers all around the coast have been enlisted in this work, including by permission of Trinity House the occupants of lighthouses and lightships. The greater number of observations of the presence of certain butterflies and moths on land do not demonstrate migratory movements, and thus those made at sea or by the shore have the greater value. Actual movements in definite directions are greatly needed, and thus continuous watch by observers is asked for. In May 1933, undoubted immigrations were noted of *Vanessa atalanta*, which were seen arriving from over the sea on the south coast. These established themselves as far north as Thurso. After September they decreased rapidly in the north, but became more common in the south than at the height of summer. In 1935 the decline in the north was more gradual. *Cardui* (painted ladies) were scarce in 1933 in the Highlands, though common in southern Scotland, and it was noticeable that when they had disappeared, *V. atalanta* still remained common. Much work remains still to be done, and additional observers are needed in this fascinating work.

In the Geological Section, Dr. Dighton Thomas read a paper on "Geology and the Community", and showed how the science touches the common interests of all classes. Much money has been wasted in the past in the search for water, coal and oil, where a little geological knowledge would have avoided the waste. Municipalities are not even now alive to the necessity of taking expert advice about such matters.

Many excursions were made to places of scientific interest. Archæologists visited the Cotswold churches of Fairford, Bibury, Burford and Faringdon. Botanists and zoologists went to the Ruskin Reserve at Cothill, where marsh, fen and aquatic plants were found. Three rounds of visits were made to Oxford colleges, the Bodleian, the Sheldonian, and the Museum of the History of Science, where Dr. R. T. Gunther explained the treasures of the Old Ashmolean.

It was announced that the Congress in 1937 would be held at Hastings under the presidency of Prof. F. E. Weiss, formerly George Harrison professor of botany in the University of Manchester.

Educational Topics and Events

BIRMINGHAM.—At the annual degree congregation, honorary degrees were conferred on Mr. W. B. Grove, a well-known mycologist, and Mr. A. E. Hills, a Birmingham manufacturer to whose generosity the University owes the new chemistry building now being erected.

CAMBRIDGE.—T. R. B. Sanders, of Corpus Christi College, has been appointed University lecturer in engineering.

W. W. Brigden, of King's College, has been elected to the Marmaduke Sheild Scholarship in anatomy. Frank Smart Prizes have been awarded to G. Metcalfe, of Clare College (Botany), and E. T. Burtt, of King's College (zoology).

At Magdalene College, Dr. D. W. Babbage, research fellow of the College and University lecturer in mathematics, has been elected into an official fellowship.

EDINBURGH.—At a graduation ceremonial on July 3 the honorary degree of Doctor of Laws was conferred on the following, among others: Sir Thomas Hudson Beare, professor of engineering and dean of the Faculty of Science in the University; Sir William W. M'Kechnie, lately secretary to the Scottish Educational Department; Prof. Edward L. Thorndike, professor of education, Teachers' College, Columbia University, New York.

OXFORD.—Dr. J. H. C. Thompson, research fellow of Merton College, and formerly of New College, has been elected fellow of Wadham College and lecturer in mathematics—a new appointment.

ST. ANDREWS.—Mr. John N. Wright has been appointed to the chair of logic and metaphysics, vacated by Prof. G. F. Stout. Mr. Wright was appointed assistant to Prof. Stout in the United College in 1920, and in 1924 became lecturer in philosophy in University College, Dundee.

Mr. T. Malcolm Knox, fellow and tutor of Jesus College, Oxford, has been appointed to the chair of moral philosophy vacant by the death of Prof. David Morrison. From 1924 until 1931 he was secretary to Lord Leverhulme, but was appointed in 1931 to a lectureship in philosophy at Jesus College, Oxford. He was junior dean and librarian of his College, a member of the Sub-Faculty of Philosophy, and a member of the Oxford University Appointments Committee.

Science News a Century Ago

John Ericsson's Screw Propeller

ON July 13, 1836, six weeks after F. P. Smith patented his screw propeller, John Ericsson, the famous Swedish engineer, also secured a British patent for a screw propeller, but of a very different design. Ericsson's propeller consisted of two drums each carrying on its exterior helical blades; the blades of each drum being inclined in opposite directions, so that one screw was 'left-handed' and the other 'right-handed'. The drums were fitted tandem-fashion behind the rudder and the invention included an arrangement by which the drums were revolved in opposite directions. The object of the duplex arrangement was to avoid loss due to the rotary motion imparted to the water by a single screw.

Ericsson fitted his propeller to the *Francis B. Ogden* in 1837 and the *Robert F. Stockton* in 1838. In 1837 the *Francis B. Ogden* towed the Admiralty barge from Somerset House to Blackwall and back. Ericsson, however, received no encouragement and afterwards learnt that Sir William Symonds, Surveyor of the Navy, had remarked that "even if the propeller had the power of propelling a vessel it would be found altogether useless in practice, because the power being applied at the stern, it would be absolutely impossible to make the vessel steer."

Biot at the Collège de France

IN its column of "Miscellanea", the *Athenæum* of July 16, 1836, said: "The learned and scientific M. Biot has been delivering some very remarkable lectures at the Collège de France. He has proved, that, by means of polarized rays, it is possible to ascertain the chemical action which takes place between bodies held in solution in various liquids; an action which has not yet been discovered by less delicate means. This is a new branch of science, created as it were by this great natural philosopher, from which the most important and curious results may be expected."

Sir John Herschel and Mr. Somerville

WRITING to Mr. Somerville from "Feldhausen near Wynberg, C.G.H." on July 17, 1836, Sir John Herschel, referring to the honour which had been paid Mrs. Somerville, said, ". . . Though what she has performed may seem so natural and easy to herself, that she may blush to find it fame; all the rest of the world will agree with me that merit of that kind is felt and recognised at length in the high places of the earth. . . ."

"We are all," he continued, "going on very comfortably, and continue to like the Cape as a place of (temporary) residence as much or more than at first. The climate is so very delicious. . . The stars are most propitious, and astronomically speaking, I can now declare the climate to be most excellent. Night after night, for weeks and months, with hardly an interruption, of *perfect* astronomical weather, discs of stars reduced almost to points, and tranquilly gliding across the field of your telescope. It is really a treat, such as occurs once or perhaps twice a year in England—hardly more. I had almost forgotten that by a recent vote of the Astronomical Society I can now claim Mrs. Somerville as a *colleague*. Pray make my compliments to her in that capacity, and tell her that I hope to meet her there at some future session. . ."

Societies and Academies

Paris

Academy of Sciences, June 2 (*C.R.*, 202, 1826–1880).

L. E. DICKSON: Solution of Waring's problem.

JEAN CABANNES and AUGUSTE ROUSSET: Measurement of the factor of depolarization of the Raman lines in gases: nitrogen, oxygen, carbon dioxide.

GEZA KUNETZ: Some properties of characteristic functions.

ALFRED ROSENBLATT: The conformal representation of restricted domains limited by general curves.

A. TOUSSAINT and S. PIVKO: Free plane stream. The influence of the supporting wings on the aerodynamical characteristics.

GEORGES SABATHE: The origin and suppression of the discontinuity in the hydrodynamic resistance of the floats of flying boats.

VICTOR MAITRE: The colour of stars of the spectral types $A0$, $A2$. The hypotheses of a distance effect and an effect of absolute magnitude have been examined separately. From a study of 335 stars of types $A0$ and $A2$, the results can be better interpreted as due to an effect of absolute magnitude than as a distance effect. An examination of the B type stars will follow.

W. ARKADIEW: The magneto-dynamic relation between the viscous losses and the permeability in very weak fields.

THÉODORE V. IONESCU: Luminous discharges observed in the magnetic field at pressures below 10^{-4} mm. of mercury. Detailed description of the light effects observed under varying conditions of voltage and magnetic field. The theory of the phenomena is not discussed.

LÉON CAPDECOMME: The role of the parasite flux in measurements of reflective powers carried out with the aid of the microscope.

ANDRÉ MORETTE: The melting point of vanadium oxychloride and vanadium tetrachloride. The thermal analysis of the system chlorine – vanadium tetrachloride. The melting point of the tetrachloride is $-77° \pm 2°$ C. and of the oxychloride, $-28° \pm 2°$ C. The results of the thermal study of the system chlorine, vanadium tetrachloride are given graphically; they show no indication of the existence of a vanadium pentachloride.

RENÉ WURMSER and MME. SABINE FILITTI-WURMSER. The equilibrium between isopropyl alcohol and acetone in the presence of alcohol-dehydrase.

MME. MARIE FREYMANN and RENÉ FREYMANN: The infra-red absorption and Raman spectra of amides and anilides and the structure of these compounds. The conclusions lead to structures differing from the classical formulæ, and favour the hypothesis of chelation already suggested by several authors.

RAYMOND AMIOT: The adsorption of binary mixtures of acetic acid and of some alcohols in aqueous solution.

MAURICE ENGELDINGER: The study of a colloidal solution prepared starting with resorcinol – formol resins.

MME. LÉONE WALTER-LÉVY: Contribution to the study of the basic magnesium sulphates.

CHARLES DUFRAISSE and MARCEL GÉRARD: Dissociable organic oxides and anthracene structure. The properties of photo-oxyanthracene. From its

chemical reactions, photo-oxyanthracene resembles anthrahydroquinone and oxanthrone, with which it is isomeric, but differs in its oxidizing power due to the peroxide function.

GEORGES DUPONT and RAYMOND DULOU: The pyronenes.

A. P. ROLLET: The polymorphism of potassium pentaborate, $K_2O.5B_2O_3$.

PHILIBERT RUSSO: The Lias at the northern extremity of the Middle Atlas.

JOSUÉ-HEILMANN HOFFET: The discovery of the Cretaceous in Indo-China.

AIMÉ RUDEL: The flora, fauna and origin of the peperites of the Puy-de-Mur (Limagne d'Auvergne).

MARCEL GAUTIER: The palæogeography of the Nemours (Algeria) region.

H. GRISOLLET: Study of the light diffused by particles in suspension in the air.

ONG SIAN GWAN: The presence of sensitizing antispermatozoids in the blood of man and of woman.

Melbourne

Royal Society of Victoria, May 14.

ANN NICHOLLS: The mineralogy of the sand fractions of some Victorian soils. A microscopical study of the fine sand fractions of some Victorian soils has indicated that soils on the Jurassic rocks contain abundant orthoclase and plagioclase, suggesting that they are immature. Basaltic soils show quartz, zircon, tourmaline and sponge spicules, which must be due to the addition of foreign material by the wind. The amount of basaltic material present depends on the state of maturity of the soil, as determined by the age of the basalt flow and the slope on which the soil is developed.

R. T. PATTON: A fossil *Casuarina* from near Bacchus Marsh, Victoria. Small teeth-like leaves, grooves on the branchlets and fruits are excellently preserved in beds which may be Miocene, as they overlie Oligocene lignites.

A. B. EDWARDS: Occurrence of almandine garnets in some Devonian igneous rocks of Victoria. Almandine is a characteristic mineral in those Upper Devonian rhyo-dacites of Victoria the magmas of which, at the time of their extrusion, had reached a state of 'silica saturation' in excess of the requirements of their ferromagnesian minerals and felspars. With further crystallization of the magma, the garnet became unstable owing to a dwindling ferromagnesian concentration, and broke down into more stable minerals, such as cordierite and biotite. Because of this, garnets are rare in granitic rocks, except in association with basic xenoliths. This process is not substantially affected by assimilation, so that the garnets appear to be pyrogenetic minerals of a 'discontinuous reaction' type.

Washington, D.C.

National Academy of Sciences, *Proc.*, 22, 249–326, May 15.

EDISON PETTIT: A second law of the motions of eruptive prominences. These prominences rise from the chromosphere and disappear at great heights during intervals of a few minutes or hours. They rise with uniform motion, modified at intervals by sudden increases as though receiving occasional impulses. From the records of thirty-eight such prominences, it is deduced that, when this sudden increase of velocity occurs, the new velocity is always a small multiple of that immediately preceding it.

C. D. LA RUE: The effect of auxin on the abscission of petioles. When the leaf-blades of *Coleus* and *Ricinus* are removed, the petioles develop an abscis layer within a few days, and fall off. Several substances known to contain the growth hormone, applied in agar-agar or lanolin, delay formation of the abscission layer; the most effective is synthetic hetero-auxin in lanoline. Their effect is greater if the plant is kept in the dark.

CHESTER STOCK: Perissodactyla of the Sespe Eocene, California.

F. ZWICKY: Extra-terrestrial effects of cosmic rays. Such effects have not hitherto been investigated. It is estimated that the total intensity due to light, atomic and cosmic rays in space is greater than 10^{-2} ergs/cm.^{2} sec. Discussing in particular the long-period variable stars, which have comparatively low surface temperatures, it is suggested that the emission by these stars of the Balmer lines with high intensity may be due to the absorption of such interstellar energy. It is also possible that the mechanical behaviour of extended gas and dust clouds in interstellar space (sharp outlines observed) may be due to corpuscular rays.

C. M. POMERAT and M. X. ZARROW: The effect of temperature on the respiration of the earthworm. Respiratory measurements over the range 9°–27° C. on normal worms, and also on worms from which the supra- or subœsophageal ganglion had been removed, show that there is an increase in rate of gas exchange with rise of temperature, as in other animals the body temperature of which is variable.

H. G. DU BUY: The change in the response of oat coleoptiles to growth regulators produced by aging. Response decreases with age at all concentrations of auxin, and the threshold concentration for curvature increases with age. The plants are sensitive to auxin only at a certain stage of development, the duration of which can be varied.

ROBERT M. YERKES and JAMES H. ELDER: The sexual and reproductive cycles of chimpanzee. Data are given from daily observations of animals at the Yale Laboratories of Primate Biology, and include records of behaviour and reproductive outcome of more than five hundred controlled matings. The sexual cycle is approximately five weeks and the period of gestation eight months.

B. D. BURKS: The nearctic Dirhinini and Epitranini (Hymenoptera, Chalcididæ). These parasitic flies exhibit great variations of structure. They are accordingly divided into five tribes, two of which are discussed and keys given.

G. A. MILLER: Groups in which the squares of the operators generate a cyclic group.

EDWARD V. HUNTINGTON: Mathematical postulates for the logical operations of assertion, conjunction, negation and equality.

SUMNER BYRON MYERS: Isometries of 2-dimensional Riemannian manifolds into themselves.

J. W. ALEXANDER: On the connectivity ring of a bicompact space.

EDWARD KASNER and GEORGE COMENETZ: Conformal geometry of horn angles.

T. Y. THOMAS: On normal co-ordinates.

MARSTON MORSE: Functional topology and abstract variational theory.

W. V. QUINE: A theory of classes presupposing no canons of type.

Forthcoming Events

FIFTH CONGRESS OF UNIVERSITIES OF THE BRITISH EMPIRE, July 13–17.—To be held at Cambridge. The Right Hon. Stanley Baldwin: President.

July 15, at 10 a.m.—G. H. A. Wilson: "Some Problems which confront Universities".

July 15, at 11.—(1) Discussion on "Provisions in Great Britain for Postgraduate Studies for British and Overseas Students", to be opened by the Right Hon. Lord Macmillan. (2) Discussion on "Functions of Universities in the Training of Teachers", to be opened by Sir Percy Nunn.

July 16, at 10 a.m.—The Hon. H. J. Cody: "The Relation of Canadian Universities to National Life".

July 16, at 11.—(1) Discussion on "Careers for University Students", to be opened by O. V. Guy. (2) Discussion on "General as an Alternative to Specialised Honours Courses", to be opened by Sir Charles Grant Robertson.

July 17, at 10 a.m.—The Right Hon Oliver Stanley: "The Relation of Secondary Education to the Universities".

July 17, at 11.—(1) Discussion on "University Examination Methods", to be opened by Dr. A. W. Pickard-Cambridge. (2) Discussion on "Physical Education in the Universities", to be opened by Dr. Carleton Stanley.

WOMEN'S ENGINEERING SOCIETY, July 17–20.—Fourteenth Annual Conference to be held in the University of Leeds.

July 17, at 7.—Mrs. J. A. Mollison: Presidential Address.

BRITISH MEDICAL ASSOCIATION, July 17–25.—Annual Meeting to be held in Oxford.

Sir E. Farquhar Buzzard: President.

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Catalogue of Types and Figured Specimens of Fossils in the Geological Survey Collections, now exhibited in the Royal Scottish Museum, Edinburgh. By Dr. E. M. Anderson. Pp. 77. (London: H.M. Stationery Office.) 1*s.* 6*d.* net. [196

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. Investigations on the Improvement of Hill Grazings. 1: The Scope of the Work, by R. G. Stapledon; 2: The Introduction and Maintenance of Nutritious and Palatable Species and Strains, by M. T. Thomas; 3: The Buried Viable Seeds of Enclosed and Unenclosed Hill Land, by W. E. J. Milton. (Series H, No. 14, Seasons 1930–1935.) Pp. iii+86. (Aberystwyth: University College of Wales.) 3*s.* 6*d.* [19

Department of Scientific and Industrial Research. Forest Products Research Records, No. 10: The Practice of Wood Bending. By W. C. Stevens. Pp. ii+9+2 plates. (London: H.M. Stationery Office.) 6*d.* net. [226

The British South Africa Company. Publication No. 4: Mazoe Citrus Experimental Station; Annual Report for 1934. Pp. xvi+133+5 plates. (London: British South Africa Co.; Mazoe: Citrus Experimental Station.) [236

First Annual Report of the Inland Water Survey Committee, 1935–36. Pp. 16. (London: H.M. Stationery Office.) 3*d.* net. [246

Imperial Economic Committee. Fruit Supplies in 1935, including Vegetables, Flowers and Bulbs; a Supplement to Weekly Fruit Intelligence Notes prepared in the Intelligence Branch of the Imperial Economic Committee. Pp. 100. (London: H.M. Stationery Office.) 2*s.* 6*d.* net. [246

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 3, No. 27: The Development of the Legs, Wings and Halteres in Wild Type and some Mutant Strains of *Drosophila melanogaster*. By Dr. Charlotte Auerbach. Pp. 787–815+1 plate. 4*s.* Vol. 58, Part 3, No. 28: The Blood Vascular System of the Elasmobranch Fish *Squatina squatina* (Linné). By B. J. Marples. Pp. 817–840. 3*s.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.). [256

The Unseen Net: an Outline of the Plan to destroy British Liberties and to enthrone Political and Economic Plutocracy. Pp. 16. (London: Liberty Restoration League.) 3*d.* [256

Facilities available at University Institutions of Great Britain and Ireland: a Handbook of Information for Overseas Students. Pp. 63. (London: Universities Bureau of the British Empire.) 1*s.* 6*d.* [266

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1935 May 1—1936 April 30. Pp. 4. (Cambridge: The Observatory.) [296

Other Countries

Canada: Department of Mines: Mines Branch. Natural Bonded Moulding Sands of Canada. By Correll H. Freeman. (No. 767.) Pp. vi+144+11 plates. (Ottawa: Government Printer.) 25 cents. [156

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 6, No. 12: Re-Examination of 64 Orbits. By W. E. Harper. Pp. 207–260. Vol. 6, No. 16: The Orbit of the Spectroscopic Binary Boss 4217. By Andrew McKeller. Pp. 291–295. (Ottawa: King's Printer.) [156

Statens Meteorologisk-Hydrografiska Anstalt. Tillhör Årsbok 17, 1935: Årsberättelse för 1935. Pp. 21. Årsbok 15, 1933. iii. Vattenständen vid Rikets kuster. Pp. 23. 2.00 kr. Årsbok 16, 1934. v. Hydrografiska mätningar i Sverige. Pp. 12. 3.00 kr. Årsbok 17, 1935. i. Månadsöversikt över väderlek och vattentillgång. Pp. 76. 2.50 kr. Årsbok 17, 1935. ii. Nederbörden i Sverige. Pp. 55. 2.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [156

Cawthron Institute, Nelson, New Zealand. Annual Report, 1935. Pp. 18. (Nelson: Cawthron Institute.) [176

Instytut Geofizyki i Meteorologji: Uniwersytetu Jana Kazimierza we Lwowie. Komunikaty, Tom 8, Nr. 93 do 109: Wyników prac Henryka Arctowskiego i jego współpracowników Natalji Chareckiej, Adama Kochańskiego, Kazimierza Korczaka, Henryka Orkisza, Jana Teśli, Wacława Wiszniewskiego i Adama Zyśki. (Des résultats des recherches de Henryk Arctowski et de ses collaborateurs.) Pp. iv+427. (Lwów: Instytut Geofizyki i Meteorologji.) [176

Svenska Linné-Sällskapets Årsskrift. Årgång 19, 1936. Pp. v+155. (Uppsala: Almquist and Wiksells Boktryckeri A.-B.) [186

Canada: Department of Mines: Bureau of Economic Geology, Geological Survey. Memoir 183: Geology of Chaleur Bay Region. By F. J. Alcock. (No. 2398.) Pp. iv+146+16 plates. 50 cents. Memoir 187: Rae to Great Bear Lake, Mackenzie District, N.W.T. By D. F. Kidd. (No. 2410.) Pp. ii+44. 25 cents. Memoir 188: The West Half of Wildcat Hills Map-area, Alberta. By G. S. Hume. (No. 2412.) Pp. ii+15+2 plates. 10 cents. (Ottawa: King's Printer.) [186

Canada: Department of Mines: National Museum of Canada. Bulletin No. 79 (Biological Series No. 21): The Freshwater Mollusc *Helisoma corpulentum* and its relatives in Canada. By F. C. Baker. Pp. 37 (5 plates). 25 cents. (Ottawa: King's Printer.) [186

Transactions of the San Diego Society of Natural History. Vol. 8, No. 18: Notes on Birds in relation to the Faunal Areas of South-Central Arizona. By A. J. van Rossem. Pp. 121–148+plates 17–18. Vol. 8, No. 19: *Crotalus mitchellii*, the Speckled Rattlesnake. By Laurence M. Klauber. Pp. 149–184+plates 19–20. (San Diego, Calif.: San Diego Society of Natural History.) [196

U.S. Department of the Interior: Office of Education. Bulletin 1935, No. 9: Public Education in the Philippine Islands. By Katherine M. Cook. Pp. 53. 10 cents. Bulletin 1935, No. 11: Education in Czechoslovakia. By Severin K. Turosienski. Pp. vii+181. 25 cents. Bulletin 1936, No. 1: Educational Directory, 1936. (In 4 parts.) Pp. iii+44+28+54+64. Vocational Education Bulletin No. 184 (Rehabilitation Series No. 24): Procedure for Survey of a State Program of Vocational Rehabilitation. Pp. viii+82. 10 cents. (Washington, D.C.: Government Printing Office.) [196

Trees and Shrubs of Kenya Colony. A Revision and Enlargement of "A Descriptive Catalogue of some of the Common Trees and Woody Plants of Kenya Colony by E. Battiscombe". Pp. xi+201. (Nairobi: Government Printer; London: Crown Agents for the Colonies.) 5*s.* [226

Yale University Publications in Anthropology. Nos. 1–7. Pp. 20+19+22+26+19+14+23+1 plate. (New Haven, Conn.: Yale University Press; London: Oxford University Press.) 9*s.* net. [226

Smithsonian Miscellaneous Collections. Vol. 95, No. 9: Preliminary Observations on Growth and Phototropic Response of Oat Seedlings. By Enoch Karrer. (Publication 3389.) Pp. ii+4. (Washington, D.C.: Smithsonian Institution.) [226

Annual Report of the Imperial Council of Agricultural Research for the Year 1934–35. Pp. iii+109. (Delhi: Manager of Publications.) 1 rupee; 1*s.* 9*d.* [226

State of Connecticut: State Geological and Natural History Survey. Bulletin No. 55: The Petrology of the Prospect Porphyritic Gneiss of Connecticut. By Lincoln Stewart. (Public Document No. 47.) Pp. 40+8 plates. (Hartford, Conn.: State Geological and Natural History Survey.) 50 cents. [226

Transactions of the National Institute of Sciences of India. Vol. 1, No. 8: Studies in the Electron Theory of Solid Metal. By N. K. Saha. Pp. 125–185. (Calcutta: National Institute of Sciences of India.) 4 rupees. [226

Proceedings of the United States National Museum. Vol. 83, No. 2989: Three New Millipeds of the Order Colobognatha from Tennessee, Texas and Lower California, with Records of previously known Species. By H. F. Loomis. Pp. 361–368. (Washington, D.C.: Government Printing Office.) [226

Doencas das Aves (Tratado de Ornithopathologia.) Por J. Reis e P. Nobrega, com a collaboração de A. S. Reis. Pp. vi+469. (Sao Paulo: Instituto Biologico.) [236

Smithsonian Miscellaneous Collections. Vol. 95, No. 11: Influence of Planetary Configurations upon the Frequency of Visible Sun Spots. By Fernando Sanford. (Publication 3391.) Pp. ii+5. (Washington, D.C.: Smithsonian Institution.) [246

Catalogues

Radiovisor Smoke Alarm Equipment. Pp. 8. (London: Radiovisor Parent, Ltd.)

British Made Mercury Switches. (List No. 1636.) Pp. 16. (London: Isenthal Automatic Controls, Ltd.)

Catalogue of the Newton Papers sold by order of the Viscount Lymington to whom they have descended from Catherine Conduitt, Viscountess Lymington, Great Niece of Sir Isaac Newton. Pp. 144. (London: Sotheby and Co.)

A Visit to our Showrooms at Aldwych House. (No. 1.) Pp. 20. (London: J. H. Sankey and Son, Ltd.)

Philips Technical Review. Vol. 1, No. 3, March. Pp. 65–96. Vol. 1, No. 4, April. Pp. 97–128. (Eindhoven: Philips Laboratory.)