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Social Science

THE question of the utilisation of science, raised in a discussion at the recent conference on academic freedom at Oxford, acquires the greater interest through both the recent meeting at Norwich of the British Association and also the way in which political affairs have directed attention to the necessity for considering how science can be used for human welfare. From whatever point of view we regard the dispute between Italy and Abyssinia, or the measures for defence against air raids now being initiated by the British Government, the question as to the misdirection of scientific knowledge cannot be evaded. Similarly, this year's programme for the meeting of the British Association has shown that in many ways the isolation of the scientific worker is breaking down and to an increasing extent he is considering the relation between his work and the society in which he finds himself.

As examples, one need only refer to the symposium on the State control of agriculture arranged by Section M (Agriculture), the discussions on the universities and business and on the future trend of scientific management in Great Britain before the Department of Industrial Co-operation (Section F—Economics), the presidential address to Section L (Educational Science) on education and freedom, part of which appears in this issue of NATURE (p. 416), the symposium on the herring problem arranged by Section D (Zoology). Discussions on the chemotherapy of malaria before Section B (Chemistry), on sugar beet problems before Section M (Agriculture), the place of psychology in the training and work of teachers before Sections J and L (Psychology and Education), the application of science to the control of road traffic before Sections G and J (Engineering and Psychology) or on the economic aspects of diet before Sections F and I (Economics and Physiology) further demonstrate over how wide a front this gathering of scientific workers considered the way in which the application of scientific knowledge can assist in the solution of social and industrial and economic problems.

Discussions of this type have for several years past been a regular feature of the meetings of the British Association, particularly discussions in which two or more sections have been associated in the joint consideration of a particular problem. The growing consciousness on the part of the scientific worker that the extent and direction of scientific work itself is influenced by the social and economic conditions under which he works, no less than the examples afforded of the disappearance of academic freedom in Europe, have quickened the interest of scientific workers in such discussions generally. Even those engaged in the most academic or theoretical investigations to-day cannot be indifferent to conditions around them, on which they depend both for the continuance of support and for freedom of investigation.

The very frailty of civilisation may demand certain limitations on the freedom of investigation possessed by the man of science, however different the purpose and form of such limitations may be as compared with the restrictions imposed in such countries as Germany and Italy. With the very continuance of civilisation itself in doubt, something in the nature of a mobilisation of scientific effort in its support becomes an urgent need. In a state of emergency the limited resources of scientific effort must be utilised where they can supply the greatest safeguard to humanity, whether in respect of supplying the knowledge and technique for the control of the forces already released by applied science, or for the development of a whole

new field of economy and technique for the distribution and enjoyment of the wider resources these forces when wisely used have made possible.

From this point of view, the right of society in a time of emergency to prescribe the directions in which scientific effort shall first be made can scarcely be challenged. Nor is there involved thereby the threat to creative thought which is involved in the prescriptions which we have witnessed of late on the Continent. We are, however, immediately confronted with a problem of co-ordination which is already suggested by such a programme as that of the British Association.

Discussions such as those we have indicated are commonly regarded as contributions to the development of social science. Granted that they represent contributions to our body of organised knowledge bearing on the problems which confront an organised society, how far do they contribute to the solution of problems as visualised by those who are seeking to attack such problems systematically by scientific methods? Can such haphazard discussions lead to the evolution of either policy or technique permitting of the solution of social problems in anything like the way in which problems of physical science are solved?

These questions and the underlying one of the evolution of sociology into a true science have recently been raised by Prof. Julian Huxley in a thoughtful article in the *Fortnightly Review*. The practice of using the term science both in the sense of an organised body of knowledge, as well as in the sense of knowledge and ideas amassed by true scientific methods, tends to much confused thought on sociology and on other subjects described by Prof. W. McDougall as social sciences. Admittedly sociology at the present time is merely a body of more or less organised knowledge, only a fraction of which has been amassed by methods which can be called scientific.

Its position in fact is very similar to that of history, and while on broad grounds Prof. Huxley may be right in objecting that history cannot be classed as a science, to push that objection too far is to be unjust to many investigators whose scientific study of historical method is yielding results of real value for the interpretation of social, political and economic situations, and may provide the basis upon which a true science may yet be built. In just the same way the transformation of sociology into a true science of society may ultimately be effected. Indeed, the scientific study of history may prove a fruitful source of accurate social knowledge.

Prof. Huxley, however, is not content merely to direct attention to the existing confusion of thought on social problems. He indicates the main requirements if social knowledge is to develop into a true science in the way that natural science began to emerge from a mere body of organised knowledge at the beginning of the seventeenth century. In the first place, he reiterates Prof. McDougall's plea for an adequate supply of workers of high standard. This is a first essential for the scientific study of social problems and at once presupposes first the provision of adequate facilities for the training of such workers and the existence of employment for such social workers when trained.

Given a supply of investigators of the requisite quality, the question of social experiments and their control at once looms large. Without experiment, social science can scarcely develop. At present the failure to isolate experiments and difficulties in securing such isolation are almost as great an obstacle to the accumulation of scientific knowledge as the prejudices which often influence the interpretation of their results. Despite the many new departures in economic and social practice which we have witnessed even in the last five years, it is almost impossible to draw sound and valid conclusions owing to the absence of control or the existence of vitiating factors.

The gradual evolution of an appropriate technique and the steady accumulation of social knowledge by scientific methods will go far to establish a definite science of society. Even then, however, such a science must differ somewhat from the physical sciences. In the main the physical sciences represent an approach to truth. In any social science it is the other aspect of science, which the physical researcher is prone to neglect, that is most significant—science as a means of control. Scientific workers must at least give a lead to the administrator and politician in such matters as a first step towards social control, and the recognition of this responsibility has already inspired a movement for integrating different branches of scientific research. One of the most valuable services rendered by the meetings of the British Association is its educational work in assisting that integration, and thus promoting a broad point of view in which the wiser direction of available scientific effort upon national and social problems becomes possible.

The Quantum Theory

The Principles of Quantum Mechanics

By P. A. M. Dirac. (The International Series of Monographs on Physics.) Second edition. Pp. xi+300. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 17*s*. 6*d*. net.

THIS is the second edition of the celebrated book that appeared five years ago, which has been perhaps the most outstanding book written on the quantum theory. The new edition has the same brilliantly distinctive style as the old. Much of the book has been rewritten, and a new chapter on electromagnetic radiation has been added at the end; but its main character is unaltered. Nevertheless, it must be confessed that on account of the lapse of time the flavour one derives from it is somewhat different.

In 1930, the great rush of discovery was only just over, and the exponents of quantum theory were still rather sharply divided into two camps, according to whether the wave-function or non-commutative algebra was regarded as the key idea of the theory. There was, of course, no contradiction involved, but tastes differed so strongly that one could really speak of rival schools. Dirac was a strong adherent of the non-commutative school, and from his book one would scarcely have gathered the predominating position in the subject that the wave-function has gained. Indeed, though, of course, he makes extensive use of such functions, he seems to regard them as a slightly discreditable confession of weakness. They constitute an admission that a perfectly abstract scheme cannot conveniently be made so that it will contain nothing but strictly observable quantities. He gives special warning against the analogy with actual waves, and the warning may be justified because the analogy is so good (at least for a single particle) that one is in danger of forgetting that it is only an analogy. On the other hand, he is much concerned with emphasising the analogy between the quantal and the classical mechanics; indeed, the development of this relationship is the spirit that animates the whole of the book.

During the last five years, the conflict of tastes has died down in the way that is usual in science, by the recognition that there was nothing to quarrel about. On the other hand, as a technical method the wave function has won all along the line. Except in one or two special subjects, no one now ever thinks of commutation rules, and even the matrix, not so long ago an almost sacred mystery, is now a perfectly natural feature of the integral calculus. There are two main exceptions to this statement. The commutation rules for angular momentum have a specially simple character, and since angular momentum governs most of the structure of atoms and molecules, the more purely dynamical methods have, in the hands of some, proved fruitful in the study of the closed system of the molecule. The second case where the dynamical methods are used has the honourable, though rather depressing, character of a 'forlorn hope'. There are some subjects which belonged to the classical scheme, but which do not fit at all readily into the quantal scheme; we are thinking in particular of electromagnetic radiation, which is discussed in the new last chapter. In such a case, the non-commutative methods make the fit distinctly less unsatisfactory, whereas the undulatory methods make the subject nearly incomprehensible. We must be thankful for the life-belt which keeps us afloat an extra half-hour, even if we drown in the end.

In the preface to the new edition, the author explains that he has made the book less abstract than before so as to appeal to a wider circle of readers, but it is not very clear what sort of readers he had in mind when he made the alterations. It was easy to see who should be the readers of the old book, for the list would include everybody who had any interest in the quantum theory, provided that he had acquired a considerable preliminary knowledge of the subject from other sources. Though the new work does not demand the same abstractness in outlook as the old, it still calls for the same amount of preliminary knowledge. For example, the first four chapters discuss 'states' and their 'representations' with no mention of what is being described or of how it is going to be done. The generalisations of these chapters will be most helpful to anyone thoroughly familiar with the technique of quanta; but they could not possibly serve as an introduction before that familiarity has been acquired, if only for the reason that no one is ready for a general idea, however well it may be presented, until he has a number of examples to attach it to. Moreover, the book calls for a knowledge of other subjects on a rather high level, and no student with any independence of character would tolerate being kept in deliberate ignorance of the main subject while he laboriously acquired all this ancillary knowledge. For example, a main idea in the book is the analogy between the quantal and the classical

'Poisson brackets'. This analogy was most valuable in Dirac's hands as a guide to the discovery of the quantum mechanics; but once found, its utility is gone because the classical Poisson bracket is a troublesome thing and much more complicated than the quantal, so that most students will profitably desert the rather arid fields of higher classical dynamics, and will devote the time saved to more interesting matters.

One character of the work is to be highly commended, and that is the author's refusal to waste time over rigorous discussions of unimportant difficulties. We may paraphrase his way of dealing with such difficulties in the words: "Though something seems a bit wrong, it can't be really serious, and with reasonable precautions there is no danger." To the rigorist, this sort of thing may be shocking, but it is typical of the author's peculiar genius in being able to use a deeper formalism than can anyone else without allowing it to overmaster him. In the same way, he does not start the quantum theory with five axioms and eleven postulates, or whatever it may be, in the way so dear to the logician, but instead describes some of the physical phenomena which demand a modification of the classical mechanics, and builds up his theory from these. He is consequently free from the danger which lies at the root of all such logical systems, that when they fail it is not the fault of any of the postulates, but of something which was so completely taken for granted that the author never knew he had assumed it.

In this work (and in some others of the Oxford series) there is a bibliographical inconvenience, which proves a quite intolerable nuisance to the reader. There are frequent back-references in the text, which are nearly always in the form :—"In equation (31) of Chapter V it was shown that . . ." At the head of every page stands the number of the section and the title of the chapter, but not the number of the chapter. Consequently in looking up every such reference it is first necessary to turn back and find the table of contents at the beginning of the book.

We fear that in the above account there may have appeared a certain lack of enthusiasm for what is undeniably a great work. This lack is to be interpreted only differentially, in the sense that we do not consider the new edition any better than the old. In the old edition, the author succeeded so admirably in expressing his philosophy that the new was almost bound to disappoint our expectation of still better things. C. G. D.

Temperature and Living Matter

Temperature and Living Matter
By Prof. J. Bělehrádek. (Protoplasma-Monographien, Vol. 8.) Pp. x+277. (Berlin : Gebrüder Borntraeger, 1935.) 18 gold marks.

IN accordance with the general lines of this series of monographs, the author restricts himself almost entirely to cell physiology; ecology and behaviour are not dealt with.

The first chapter is of an introductory nature, and is short. In the next three the author proceeds to an exhaustive discussion of the effect of temperature on the rate of biological processes, and its physical and mathematical interpretation. He explains the theory of the Q_{10} rule and the Arrhenius equation, and points out objections to their use as a means of manipulating experimental data. In particular, he takes exception to the use made of the Arrhenius equation by Crozier and his school. He proposes to substitute for these formulæ a simple empirical equation of the form $y=a/t^b$, where y is the time occupied by the process, t is the temperature, and a and b are constants, the latter having the meaning of a temperature coefficient. This coefficient, b, has, of course, no theoretical significance; but the author claims that it is constant over the whole temperature range in many processes in which other coefficients are found to vary with the temperature.

The classification of biological processes into 'physical' and 'chemical' on a basis of temperature coefficients is unsound, since many physical processes have high temperature coefficients; to make deductions as to the biochemical nature of these processes from their temperature coefficients is clearly still more rash. Bělehrádek's interpretation of the effect of temperature is as follows: Others have tacitly assumed that a chemical process is always the limiting factor in biological reactions, but there is no reason why a physical process, for example, diffusion, should not be limiting, since it can be shown that a high temperature coefficient is not incompatible with such a process; for if diffusion is limiting, it will be affected by the viscosity of the protoplasm, and the rate of the biological process will thus bear the same relation to temperature as does protoplasmic viscosity. The author then proceeds to adduce evidence in

support of his views, and although the theory has met with much criticism it is set forward very convincingly in this book.

The next three chapters deal with the effects of temperature on the chemical, morphological and physical properties of living systems. The question of viscosity is discussed at length, which is not surprising in view of its importance in relation to the author's theories.

Chapters viii and ix concern the relation of living matter to low temperatures, involving discussion of cold-hardiness, chill-coma and the causes of death by freezing. Evidence is brought forward to support the suggestion that chill-coma and the fatal effect of low temperatures (apart from freezing) are due to the increased viscosity, which practically stops all biological processes.

Chapter x, the longest in the book, is devoted to injury by heat and heat resistance, and the last chapter, an account of the stimulative effect of temperature, is necessarily short since a consideration of sense organs and behaviour is beyond the scope of the book.

The first four chapters cover ground which is of fundamental importance to all students of experimental biology. Throughout the book, the systematic arrangement of facts makes it a valuable addition to any library, even though these facts do not lend themselves to any very comprehensive generalisations. The size of the bibliography bears witness to an amount of work for which Prof. Bělehrádek deserves the gratitude of all biologists.

J. A. R.

Motor Fuels

The Principles of Motor Fuel Preparation and Application

By Prof. Alfred W. Nash and Dr. Donald A. Howes. Vol. 1. Pp. xiv + 538 + 9 plates. Vol. 2. Pp. xiv + 523. (London: Chapman and Hall, Ltd., 1934–1935.) 30*s*. net each.

THE reputation of Prof. Nash as a teacher and leader in the petroleum industry is such that any book from him is assured of a sympathetic reception. He has had the assistance of Dr. D. H. Howes, of the Anglo-Persian Oil Co., and his venture is launched with a foreword from Dr. A. E. Dunstan, in itself no mean recommendation.

It is common knowledge that one of the wonders of the world, something which is influencing the daily life and comfort of every one of us, is the modern high-speed, high-efficiency internal combustion engine. This requires fuel to drive it, and so a variety of problems have been set to the oil chemist which are by no means solved, and therefore still in the forefront of interest.

Knowledge, when it has a bearing on everyday life, travels apace, so that even the schoolboy and his sister talk glibly of anti-knock and gumming. The use of petroleum on its present scale is relatively a new thing; it is said that up to the present only two thirds of a cubic mile of oil has been used, and the rate of progress, which is amazing, is largely due to the fact that science has from the outset been so largely applied to the problems. As Prof. Nash says, a team of geologist, petroleum engineer, refinery chemist, business man, and sometimes physicist and mathematician, to which we would add men of energy and enterprise, has co-operated to discover, produce, refine and distribute petroleum and its products. As motorists, most of us expect to be able to stop by the roadside and refuel at a wayside pump almost at will, and it is not realised how great an organisation, how much technical effort is behind this most efficient service.

The work as a whole is divided into two volumes, of which the first deals with the production of the motor fuels by distillation, cracking, extraction from natural gas and hydrogenation. It also deals with the rival fuels not originating from petroleum, for example, benzole and alcohol. The problems of oil storage, insurance and distribution are also briefly touched upon. The second volume describes the subjects of analysis and specification, the 'gum' question, which is one of importance, internal combustion and Diesel engines and knock ratings. A chapter is devoted to aviation fuels.

The primary object of the refiner is to obtain from crude petroleum a fraction which distils over a range from 35° to 200° C., which is redistilled, etc., to marketable petrol: the book is not concerned with the subsequent operations to lubricating oil, fuel oil and asphaltic products.

Straight distillation only yields a proportion of petrol according to the nature of the crude, and as petrol was the most valuable product, means were sought to increase the proportion and were discovered in the process of cracking. In general, during cracking, low boiling constituents are produced by the breaking down under the influence of heat of the larger molecules present in the oil,

some hydrocarbons of even greater complexity being produced at the same time. Though simple in principle, cracking has offered many difficulties in practice: it is largely practised, and the total amount of petrol yielded by a ton of crude oil has materially increased in consequence, thus helping to conserve the world's oil resources.

At the well-head a great quantity of gas is liberated saturated with the lighter liquid hydrocarbons, though in itself it consists mainly of methane. It is customary and necessary to scrub out these liquid fractions before the natural gas can be pumped great distances, so there is available a considerable quantity of highly volatile spirit which is blended so far as possible with the ordinary distillates. There is naturally a limit to this blending process, and at the moment the large amount of butane for which there is no use remains one of the problems of the industry.

Every means is thus taken to obtain the maximum amount of motor fuel from a particular crude oil, which then is subjected to a drastic refining process so as to remove all constituents likely to be harmful to the engine of a motor-car, in particular the sulphur compounds—this subject receives full treatment by the authors.

In countries like our own, where there is no natural source of oil, other home sources of fuel naturally receive consideration. One of these is benzole, a by-product of the coking and the gas industry. The first effort to market this by William Butler of Bristol in 1903 was not very successful, and it was not until the formation of the National Benzole Association in 1919 that a satisfactory marketing organisation for this product, which is sold mixed with petrol, was attained. To-day 'National Benzole' is a well-known product, and the quantity of benzole produced in Britain is continually increasing, though it remains small compared with the total amount of motor fuel.

Considerable interest is attached to a second motor fuel, namely alcohol, which in many lands is likely to be widely used as the result of legislative enactments. The advances in fermentation technique, the use of cheap molasses as the source of sugar and the discovery of processes of dehydrating alcohol so as to make an anhydrous product miscible with petrol in all proportions, have done much to make alcohol practicable as a motor fuel and competitive so long as petrol bears its present high rate of duty. Methods have been worked out for making alcohol from ethylene gas, and where this is available in quantity the process is also a commercial one. If the supply of petrol failed or the product became very costly, there is no doubt alcohol could largely take its place. A lengthy chapter is devoted to the intricacies of this question: it handles also the production of methanol from water gas and the use of this alcohol as a fuel.

The production of oil from coal, either by low-temperature carbonisation or hydrogenation, is as yet in its infancy, though there is a certainty that progress will be made in both directions during the next decade. Such oils are to be regarded as home-produced crudes of special character, and they will come into the hands of the refiner for treatment. In comparison with the processes discussed, the crude oil obtained by distilling shale is barely competitive, and in normal times cannot be regarded as a serious source.

Prof. Nash has given us a scholarly and informative work which should have wide patronage. He makes clear the advanced state of the industry as regards scientific knowledge and the amount of research and development which is taking place. It is satisfactory that there are in Great Britain schools of petroleum technology of university rank and high standing. It is desirable, however, that the practice of refining be also encouraged by every possible means, lest from lack of practical operation we lose contact with what perhaps are the most forceful developments of the day in chemical engineering technology. E. F. A.

The New America: the New World
By H. G. Wells. Pp. 96. (London: The Cresset Press, Ltd., 1935.) 2*s*. 6*d*. net.

STRESSING the general problems rather than details, Mr. Wells in a series of four short but brilliantly written chapters emphasises the necessity for the deliberate readjustment of the social mechanism, so as to realise the possibilities of human expansion that are now running to waste and disaster. He holds that, if an effort is to be made at all to find a way out from catastrophe to a new lease of life for civilisation, the main part of it should come from America, as no other country has the necessary freedom of speech and mind left and all other communities are confused by the war threat.

During his recent visit to America, two aspects of that country's effort to adapt itself to the new conditions seemed to Mr. Wells unique. The first is that the struggle to reconstruct in America goes on in an atmosphere of unbridled public discussion, whereas in Britain it is restrained by habit and custom and by the centralisation of the Press in London. The second is the relative unimportance of large mass antagonisms. There is no widespread conception of a class-war ruling the situation as in Russia, or of racial incompatibility as in Germany or any such exacerbation of xenophobia as in Italy or Japan. There are conflicts of regional interests, indeed, but little regional bitterness.

Practical Applications of the Punched Card Method in Colleges and Universities

Edited by G. W. Baehne. Pp. xxiii+442. (New York: Columbia University Press; London: Oxford University Press, 1935.) 22*s*. 6*d*. net.

THE use of tabulating machines of the Hollerith electric or other types for statistical and recording work of all kinds has increased to a remarkable extent during the past fifty years. It is not, however, generally appreciated how valuable these devices have proved themselves not only in large-scale and intricate accountancy systems but also in actual statistical research in the wide and varied field of social science. The present work describes their use mainly in colleges and universities, for example, in the registrar's and business office and miscellaneous administrative applications, and in psychological, educational, medical, hospital, legal and agricultural research. In their present wonderfully improved form, the Hollerith machines work automatically with such speed and unerring accuracy in complicated statistical manipulations that, to the uninitiated, they seem like uncanny 'robots' of superhuman efficiency.

The experience of the large number of American universities and other institutions here recorded shows that both in the ordinary business routine of a registrar's office and in social research of every kind, such mechanical devices are proving to be increasingly necessary, as essential indeed as mathematics, and are, as the editor rightly insists, the natural outgrowth of the statistical method of approach to modern learning. One writer in the authoritative series of papers here presented from many fields of university and institutional activity expresses the view that, with the statistical approach so perfected by these means, a precision and dependability of research in the social sciences will be secured second only to that of the physical sciences. So far from mechanising thought, the vast reduction in time spent on laborious routine will increase the time available for clear and original thinking and accurate observation.

The Aliphatic Free Radicals

By F. O. Rice and K. K. Rice. Pp. 204. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1935.) 21*s*. net.

THE capture of particles elusive and ephemeral by Paneth and Hofeditz has proved a turning point in the century-old controversy around the question "Do free radicals exist?" In justice to recent developments, the Faraday Society's discussion in September 1933 centred chiefly round entities falling within the definition: "Free radicals are complexes of abnormal valency, which possess additive properties, but do not carry an electrical charge and are not free ions". The book under review is concerned with such radicals, of which "the most striking property is their short life".

The detection and incidental synthetic uses of free methyl, methylene and ethyl are lucidly described, and a hypothesis of thermal decomposition of organic vapours, consistent with many of the data, is based on the intermediate formation of free radicals. The authors are bold enough to prophesy in detail the courses of numerous reactions not yet investigated. Cognate reactions in the liquid phase are briefly discussed, and the hypothesis is extended, with some success, to the decomposition of large non-volatile organic molecules of the recurring-unit type. There are a few slips, such as the description of methyl and ethyl nitrites as "the methyl and ethyl esters of the alkyl nitrites" (p. 138).

Readers interested in the mechanism of reactions will, however, find this a useful, well-produced book with a comprehensive up-to-date bibliography limited by the scope of the title, but the price seems rather high to command a ready sale to individuals.

The Hardness of Metals and its Measurement

By Dr. Hugh O'Neill. Pp. xiv+292+24 plates. (London: Chapman and Hall, Ltd., 1934.) 25*s*. net.

ALTHOUGH the hardness of a substance is not a physical constant, and cannot be expressed as a function of known physical constants, the idea of hardness is a familiar one, and empirical determinations of hardness play a great part in the study of materials. Methods depending on scratching now take only a subordinate place, and 'resistance to indentation' is the most generally accepted definition of hardness. The Brinell test, in which a hard ball is pressed into the object under a known load, forms the basis of most hardness testing, but the introduction of the diamond pyramid, as in the Vickers test, in place of a steel ball, has given greater precision to the test.

The author of this useful manual has made a special study of hardness, and is known as an investigator of the subject. Besides a clear account of the methods of determining hardness in the laboratory and in the workshop, the book deals fully with the influence of the time factor in deformation and with the relation of Brinell hardness to such mechanical properties as tensile strength and capacity for work hardening. The author emphasises the value of 'Meyer analysis' in the investigation of the latter property. Such subjects as resistance to abrasion and the cutting quality of tools and cutlery are also discussed. The manual will be found of the greatest value as a work of reference. C. H. D.

Esquisse du progrès de la pensée mathématique: Des primitifs au ix^{e} Congrès international des Mathématiciens. Par J. Pelseneer. (Bibliothèque scientifique belge.) Pp. 161. (Paris: Hermann et Cie, 1935.) 15 francs.

IT is not the technical results of mathematical progress, but rather the development in the outlook of mathematicians, which is very ably sketched in this little book. From the primitive attempts of reckoning to the dizzy heights of contemporary mathematics, we thus have before us an ordered and most suggestive exposition of the mathematical atmospheres of the ages. Selected quotations from the leading mathematicians help us to understand the progressive changes in their interests and methods. This is an interesting contribution to the history of science. T. G.

Education and Freedom*

By Dr. A. W. Pickard-Cambridge

NO one with any power of discernment can have failed to note two opposite tendencies at work in the present day: one, a tendency antagonistic, both in intention and in fact, to freedom; the other, a tendency to lay claim to freedom in ways which it is not always possible to defend. The second of these tendencies is seen in a number of educational theories which would, so far as possible, exclude discipline from life in the supposed interests of free development; and also in a certain impatience with all forms of authority, of which those who are associated with young people have been more conscious in recent years than, for example, before the War. But the other tendency we can see writ large on the recent history and present condition of nations and also reflected in the smaller letters of individual mentalities. In Germany, Italy and Russia we are watching the complete subordination of the individual to the State, not only in his external life and action, but also, so far as education and propaganda can achieve it, in thought and will.

If such phenomena were only presented to us by foreign peoples, they would even then merit our very serious attention; but he would be very blind who did not see the same tendency at work among ourselves. We call ourselves a democracy, and the essence of democracy is that it rests upon the free expression of individual thought; but the rigidity of organisation in our political parties has increased during the present century to an ominous degree, and with it the application of what is called 'party discipline', depriving the individual of all freedom of action and speech, whatever freedom of thought he may privately retain. It is at least equally serious, that some of the constructors of the imaginary Utopias which have been most popular with the younger generation in the last few years clearly envisage and apparently approve of political and educational systems based upon the complete elimination of individuality.

Now if this view is accepted, if it is definitely decided that freedom is not worth keeping, the consequences in the field of education will obviously be accepted also—the strict control of all that is to be taught, and of the method of teaching it; the exercise of thorough-going espionage upon teachers and pupils, and the encouragement in both ranks of the giving of information against colleagues and companions; the supervision of every part of the individual life, so that there may be no loophole anywhere for the intrusion of counter-influences, and no opportunity for the expression of free thought. There may be those who feel that such a state is what ought to be; and I do not now propose to argue with them; but what I have to say is based upon the opposite assumption, that individual freedom, subject to such a minimum of restriction and organisation as is necessary for life as a member of a community, is the indispensable condition of a good and even a tolerable human existence, and that just as the educational systems of coercive States, real or imaginary, are directed to the maintenance of the systems of government and life which have given rise to them, so the educational system of a democratic State, which is based on the principle of freedom, should be directed towards the maintenance of that freedom, and the encouragement of its responsible use. As the principle of the direction of education in accordance with the 'spirit of the State' must necessarily result, in the authoritarian State, in training citizens *not* to think, so education in the spirit of a polity of free men and women must above all train them to think freely and accurately, and to desire to carry the results of their thinking into action. As the former type of State will try to produce a standardised and unresisting mentality, the latter will allow the utmost variety and will look for the good life of the community to the clash in rational discussion of the most diverse views, brought to judgment before the bar of a public opinion in the formation of which all alike may take their part.

The ideal State and community will be a democracy in which every individual is free to realise the highest values, physical, moral and spiritual; and the realisation of some of these is only possible if he can enter into freely determined mutual relations with others, participating fully in the life of the community, communicating his share of good to it, receiving his share of good from it. The community and the State will recognise fully the value of the individual personality, and will acquiesce in no condition which makes any individual merely a means to the well-being of others, or to the stability of the organised

* From the presidential address to Section L (Educational Science) of the British Association delivered at Norwich on September 6.

community, for the sake of which in authoritarian States, real or Utopian, individuality is sternly suppressed.

But the desired freedom of the individual has to encounter obstacles of more than one kind, and it is in a great measure with these that education has to deal. The obstacles are partly in himself, partly in the community. It is obvious at once that no one, as he is, is completely free. Everyone is greatly hampered by the effects of heredity, which, whatever the mechanism, seem to be mental as well as physical; by the influence of body upon mind; by the tendencies imparted by early environment and habituation; and by the results of his own actions. Yet it is probably a fair summary of what may be inferred from common experience, that each individual has at any moment a certain balance or reserve of freedom, that is, of power to act in the way which he recognises to be good—a balance or reserve which he can increase or diminish by every individual act, every exercise of will, so far as he *is* free. Therein lies (as all moralists have seen) the importance of each single action; for it is in the determination of single actions that increased freedom must be won. By constant action in one direction, habits are formed which it is very difficult to break. By repeated choice of the higher as against the lower values, the choice of these becomes easier; freedom is increased. Accordingly, one purpose at least of education is to set what seem to be the higher values before the immature mind in such forms as it can understand, and to encourage the habit of choosing them. About most of these higher values there is really very little doubt, and in such forms as kindness, unselfishness, truthfulness, fair-play, thoroughness, neatness and other elementary kinds of beauty, they are as accessible to young minds as to old.

Further, the importance of discipline depends upon the fact that without it—without a certain external compulsion at times—the immature personality may not discover that it *has* the freedom to choose something other (and, as it will afterwards recognise, something better) than that which immediately appeals to it. Discipline, correction and guidance reveal the power of choice—of doing what you do not want to do; and in time self-discipline follows and freedom increases in proportion—freedom, that is, to pursue and realise ends or values deliberately chosen, because they are recognised as good. No one can possibly be less free than one who has always been allowed to do what he likes; he will never have discovered that he can do anything else. To deprive the young in the name, forsooth, of freedom, of all benefit from the experience of earlier generations—to put *no* values before them as good—is not, in fact, to increase, but to restrict their freedom by denying them the conditions of a fair choice. The young mind has neither the information nor the training to decide everything for itself. But it *is* the object of education and of discipline that it may ultimately have these, and may do some things, no longer because they are imposed by authority, but because they are recognised to be good, and other things, it may be, because the ideas suggested by authority have now been revised and modified by the growing reason. If the discipline and guidance are accompanied, so soon and so far as is possible, by reasons which will not only suggest why it is that such and such acts and habits are good and so cause the discipline to be willingly accepted, but will, above all, help to form the habit of reasoning and of considering what *is* good or bad, the result, so far from hampering freedom, will be to elicit and enhance it.

It is clear that over and above the influence of wise suggestion and example, not only in the general life of the school as a society, but also in the choice of literature, in the study of characters both in literature and history, and in the presentation, in however simple a form, of the working in history of cause and effect, an immense opportunity is open to the teacher.

But education has much more to do in the cause of freedom than the encouragement of a habit of discriminating between good and evil, or better and worse, and the suggestion of the lines of such discrimination. For before life is far advanced, the simple problems and issues of early days are merged in far more complicated issues, requiring the utmost clarity of thinking; and not only does the true discrimination between values itself become more difficult, but also a knowledge of facts, a power of analysing them and appreciating their bearing, and therewith an understanding of the particular conditions in which the realisation of ideals of good has to be attempted, become essential; in short, a clearness of perception and judgment without which the best intentions may end in disaster.

For effective thinking two conditions are necessary: first, that the materials with which thought has to deal shall be so far as possible true, or, in other words, that truth about facts shall be accessible; secondly, that the mind itself shall have been trained to work accurately and honestly; and if freedom in political and private life is to be preserved, those who educate others must put them in the way of obtaining truth about facts and of distinguishing truth from falsehood in what is presented to them and in their own reasoning. It would take a very brave man to deny the immensity of the obstacles. Even in a country so free as our own, the temptations to accept opinion

manufactured by others, not always for the best ends, are enormous.

Yet preparatory work may be done on the lines which are followed, at least in a few schools, in which in some upper forms present-day problems are discussed, or the news of the week presented, in ways which encourage older boys and girls at least to think about them, to be aware of the two or more sides that each question presents, to realise the duty which lies upon them, or will shortly lie upon them as citizens, to get the best information and to form their opinion with a high sense of responsibility and a disregard of the interest of class or self. They can be led to realise that democracy is less a system of equal rights than a system of equal responsibilities ; and even the common life of the school can teach them how much one clear and decided mind can do in shaping the opinion of its own circle. The foundation of habits of impartial and critical judgment *can* be laid at school, and if they are not laid there, the odds are heavily against their being laid anywhere else. The teaching of history is an obvious instance of the opportunity which education affords for the formation of habits of careful judgment. As in all other matters, there must be an impartial presentation of facts and issues, and, if possible, opportunity of discussion of a kind suited to the age of the pupils.

In other ways, the dangers of dependent, unventuresome and even servile mentality may be partly met by the school. Young people are much more likely to *think* for themselves, if, subject to the necessary framework of school discipline which is scarcely felt so long as it is wisely controlled, they *do things* for themselves. This is well understood in the older public schools, but I confess that in a great number of secondary schools—and secondary schools are of special importance, because from them should come the leaders of opinion in nearly all those smaller circles in which, much more than on platforms, public opinion is made, as well as most of the future teachers of the mass of the people—I should like to see a good deal more room for independence and self-government. It is impossible to train young people in the free use of judgment without letting them exercise it freely in their own affairs and (with slight and obvious limitations) make their own mistakes, and grow in the power of judging how to act and of understanding the characters one of another ; for in a free State, the power to choose persons is as important as the power to choose between policies, and there is no place so good as a school for learning either to lead or to choose and follow a leader.

Again, no one can deny the effect of the mechanised drama, which is the almost universal recreation on certain days in the week, in producing a standard mentality (one might almost say a uniformity of bad taste) and in confining interest to monotonously narrow lines ; and the fact that the interest in sport of which our countrymen boast takes, for nine-tenths of them, the form not of healthy personal activity but of massed attendance at the performances, provided for them by no effort of their own, of two teams of hired entertainers or of a few trained dogs, is not indicative or productive of an active intelligence. If education is to counter this, it must encourage those occupations of leisure in which the individual can exercise his own free choice and express himself—the performance (not merely the hearing) of music and drama, the practice of handicrafts, of arts, of gardening, of all kinds of performances which are personal, not mechanical. It must set before the young the infinitely various ways of spending time worthily ; and must encourage an attitude towards books and reading which few of our examination-ridden youth attain. For all these things are the activities of free minds, not of those which accept unthinkingly everything which is superficially attractive and is therefore accepted by crowds. Without some such influence from education, we can expect only passive minds, barren of ideas, and unable to rise by freedom of thinking to meet the perpetually changing needs of the world in which they are called upon to live.

As I have spoken of examinations, I had better say explicitly that I rank examinations, not in themselves, but as they are treated in most schools at the present time, among the worst enemies to education in freedom of thought and independence of judgment. Examinations can be, and should be, invaluable aids to education ; but it is a condition of this that they should be only an incident in the work of the school, testing at convenient points the work of both teachers and pupils, and really, and not merely by profession, following and not directing the curriculum. Their usefulness is undoubted in training the young mind to do what it will continually have to do afterwards—namely, to bring whatever knowledge and resource it may have to bear on a particular point at a given moment, and in this both intellectual and moral qualities are involved. But where the whole work of the school is planned to cover or lead up to the syllabus of some particular examination ; where every subject is studied at a rush in order to work into the pupils' minds what are virtually prescribed answers to questions which may almost be said to be prescribed, so narrow is the range from which they can be drawn ; where the teacher does not dare to encourage his pupils to think ; where he cannot go at his own pace and cover in his own way the ground which he can effectively cover, for

fear of the effect on the statistics by which the local education authority, knowing little of education, judges the efficiency of his school and his own fitness for promotion, or by which the employer, knowing even less, judges the suitability of individuals for purposes never contemplated by the examination authorities—there examinations are a very mischievous thing. Unless the habit of working and teaching for examinations before everything else is abjured, I see little hope of the type of education which alone can save democracy, and bring up a race of free men and women.

There are other reforms which are urgently needed, if our present system of education is to be brought nearer to the fulfilment of such an end. The prolonging of the time of education is obviously one, provided that the education is of the type which liberates and trains the mind, and does not merely rivet its fetters more tightly. A great reduction in the size of classes in most subjects is another; not necessarily in all subjects, or for all purposes; but such a reduction as will give the individual member of the class a chance, and will enable a teacher to encourage a pupil who has a line of his own to follow it up, and to see that every pupil is mentally active and not merely receptive. Young people have not indeed enough experience to prescribe or to conduct their own studies to the extent imagined by some enthusiasts; but they have minds which should not be allowed to be inert or be driven along precisely the same route as twenty-nine or thirty-nine other minds, and the smaller the class the less the risk of this.

The suggestions which I have made as regards educational practice have nothing new in them, but I have deliberately chosen familiar instances to illustrate my main contention. My object has been to assert that these are no matters merely of theory or of finance or of administrative or political convenience, but of vital and immediate urgency, if we are not unconsciously to bring up a race which, with its mind stunted, its capacity for freedom undeveloped, will be the easy prey of the politician, the journalist and the dictator; and that if a free democracy is to continue, we must educate for it, for in many respects our present educational system is better calculated to produce a servile and passive mentality than to elicit an activity of mind and an independence worthy of free men and women.

We have reached a point in the history of Western civilisation when the forces which make for the enslavement or the inertness of mind and spirit are active as they have not been for centuries. It is therefore incumbent upon us to test our educational institutions and methods at every point by their tendency to produce or to hinder freedom of mind, to cut out all that makes for the standardisation of individualities or is hostile to ultimate independence of judgment, at the same time so setting before the young the higher values, which make for good life and good citizenship, that they may have the chance of freely making them their own. If we can do this, we may yet see the development of a type of humanity richer in freedom, self-discipline, courage and vision than any which the world has yet known.

Recent Progress in the Study of Early Man*

By Sir Arthur Smith Woodward, F.R.S.

WHEN meeting in East Anglia it is appropriate that the Section of Anthropology should devote special attention to prehistoric archæology. In this part of England so long ago as 1797, John Frere made the first scientific observations on palæolithic implements which he had dug out of a superficial deposit at Hoxne. During recent years, Mr. J. Reid Moir has excited wide interest by his discoveries of the oldest known stone implements, which he has collected with remarkable zeal and discussed with acute observation. Here also arose the 'Prehistoric Society of East Anglia', which has been so well supported during its career of more than twenty years, that it has gradually widened its sphere until now it becomes the 'Prehistoric Society', devoted to advances in its subject in all parts of the world. We are, indeed, now confronted with problems much greater than those which the pioneers in western Europe dealt with, when they were laying the foundations of research in prehistory. Traces of men who lived before the dawn of history in widely separated parts of the earth's surface have been discovered in increasing abundance during recent years; and a study which at first was more or less local has now become one of world-wide scope.

Among the several branches of science which contribute to our understanding of the subject,

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those of palæontology and geology are of considerable importance. The period of man's existence on the earth has been so short that there has been no appreciable evolution among the mammals associated with successive human races; but many migrations and extinctions are observable, so that these mammals can often be used for determining the relative ages of the isolated deposits in which human remains and implements occur. In some cases also the mammals are probably enough to show the nature of the climate and the local conditions under which they lived. The contemporary geological changes, though small, likewise help in explaining migrations and perhaps some extinctions; while the peculiar circumstances of the Great Ice Age, under which early man flourished in the northern hemisphere, varied so much from time to time, that they have been used in forming a plausible chronology. As a palæontologist and a geologist, therefore, I propose to discuss some of the latest developments of prehistory.

It has long been recognised that the earliest men of which traces have been found in Europe did not originate on this continent, but were immigrants from some other region. It is thus important to examine the numerous associated mammals to ascertain whence they came; for most of these mammals seem also to have been immigrants to Europe just before or during the Pleistocene period when man began to live here, and they may give a clue to his origins.

Sir W. Boyd Dawkins was one of the first to take a broad view of the mammals which accompanied the successive races of early man in Europe, and he eventually published a map to illustrate their mixed origin. In addition to some which were already in the middle of the European continent, others seemed to have come south from the Arctic regions, others had passed directly west from the middle of Asia, while a few could only be explained as having come north from Africa over old land bridges to Gibraltar and southern Italy. These mammals might not all have lived together, but they at least showed how varied were the routes open to the movements of primitive men.

It now appears that the tracing of the warmer types of mammals to an African source was a mistake. Recent researches seem to have proved that during the Pleistocene period there was no direct communication between Europe and Africa, either through Gibraltar or through Sicily and Malta. Geologists are satisfied that certain shells which are characteristic of northern seas could not have entered the Mediterranean to be found there in Pleistocene sea beaches if the Straits of Gibraltar had not been open. Others have remarked that among the numerous remains of mammals which occur in some of the caves at Gibraltar, there is nothing distinctly African. Dr. Raymond Vaufrey has more recently examined the fossil mammals and stone implements found in the caves and other Pleistocene deposits of Sicily and Malta, and he shows clearly that although these islands were connected with Italy at the time, they never had an extension to Africa.

The latest discoveries of fossil mammals in the caves of Palestine and Syria, as interpreted by Miss Dorothea M. A. Bate, show that during the early half of the Pleistocene period, Asia and north Africa were much more closely connected than they have been since. The country was comparatively well watered, with luxuriant vegetation and forests, and mammals could readily migrate both east and west. Even so characteristic an African animal as the wart-hog (*Phacochœrus*) was then living in Palestine. The connexion of Asia with Africa was thus as definite as that with Europe; and the explanation of the partial identity between the Pleistocene mammals of Africa and Europe is probably that they had a common source in Asia, and diverged west in two different directions, one southwards, the other northwards.

This conclusion is supported especially by the apparent origin and former distribution of the spotted (or cave) hyæna, *Hyæna crocuta*. In the Pliocene deposits of the Siwalik Hills in northern India, there are jaws and other remains of hyænas which are not quite *H. crocuta*, but may well represent its ancestors. By the Pleistocene period, the typical *H. crocuta* was already in existence in India, as shown by a tooth discovered in the Karnul caves, Madras. Remains of the same species have also been found in Pleistocene deposits in central Asia and even in China. They are likewise widely spread over Syria and northern Africa, where only the striped hyæna (*H. striata*) lives to-day. *H. crocuta*, therefore, is not an African animal. It originated in Asia, spread thence in different directions in the Old World, and has survived only in southern Africa, which is at one extremity of its former wide range.

It is also to be observed that none of the characteristically African antelopes occurs among the European Pleistocene fauna. Remains of the gazelle have been found, but this animal is as much Asiatic as African. The Saiga antelope and *Nemorhœdus*, which are Asiatic to-day, are the only other antelopes which reached Europe in Pleistocene times.

The Pleistocene mammals of Europe, therefore, show that when they flourished on this continent, the only direct land communication was through Asia. The earliest races of men must have reached western Europe by that route; and as a succession of stone implements, remarkably similar to that

which is now so well known in Europe, has already been found with early Pleistocene faunas in Africa, it might at first be supposed that there were parallel migrations of the same men from the Asiatic to the African continent. Implements, like languages, however, afford no certain clue to the races which made and used them, and the same tools must have been invented independently more than once. It is therefore unfortunate that hitherto no human remains have been found in undoubted association with any of the earliest implements and Pleistocene mammals in Africa.

Two years ago a committee of geologists which met in Cambridge expressed itself as satisfied with evidence which Dr. L. S. B. Leakey submitted in order to prove that he had discovered modern types of human skull and lower jaw with very primitive implements and early Pleistocene mammals in Kenya Colony. In fact, it appeared as if the same types of implements in the same geological stage in Europe and Africa had been made by two distinct genera of men. Quite lately, however, Prof. P. G. H. Boswell, under the guidance of Dr. Leakey, has examined the geological formations in the region where the discoveries were said to have been made, and he is now convinced that there is no proof of the association which has been claimed. The human remains in question seem to have been obtained from disturbed deposits, and may have been buried at a comparatively recent date. With later types of stone implements and remains of modern mammals, the only satisfactory fragments of the human skeleton which have hitherto been found in Africa belong to the genus *Homo*. Many of the fossil forms are related to the surviving South African bushman, and if any of these passed directly from northern Africa into Spain, as has sometimes been supposed, they must already have learned to make rafts by which they could cross the Straits of Gibraltar.

The only fossil hitherto discovered in Africa, which suggests that that continent may have produced man, is the immature skull from a deposit of uncertain age (probably Pleistocene) at Taungs in Bechuanaland, which was named *Australopithecus* by Prof. Raymond A. Dart in 1925. It belongs to an ape, and seems to exhibit more human characters than the skull of any of the existing apes; but Prof. Dart's complete account of the fossil has unfortunately not yet been published.

The earliest known jaw of an ape, *Propliopithecus*, was discovered long ago in the Oligocene of Egypt, and numerous jaws of apes related to the existing chimpanzee are now being found in the Miocene of south-east Africa. Equally abundant, however, are the jaws of apes in the Mio-Pliocene deposits of northern India, and some of the teeth preserved in them exhibit a remarkable approach to those of man. I still think, indeed, that according to our present knowledge, the links which connected apes with man are most likely to be found in south-central Asia. As the late Joseph Barrell pointed out, the east to west ridge of the Himalayan Mountains was gradually raised up at the time when northern India was covered with a great forest which swarmed with apes of many kinds. The formation of the ridge separated off a northern portion of the forest which became subject to comparatively inclement conditions. The apes stranded in this northern portion would be disturbed by the extensive destruction of the trees, and the survivors would be driven to be ground-apes and change their habits of feeding. They would thus be modified in the direction of man.

These considerations, with the geographical distribution of the few oldest known remains of fossil man, led the late Dr. Davidson Black to make plans for a systematic examination of the later Tertiary deposits of south-central Asia. In 1925 he reviewed the whole subject in an important paper published by the Geological Society of China. In the summer of 1932 he actually traversed a route from eastern China, through northern India, to Syria and the western coast. Dr. Black, unfortunately, did not live to see the realisation of his project, but we are glad to learn that Father P. Teilhard de Chardin will take his place in researches beginning in India this autumn.

It is very interesting to notice that if central Asia was actually the region in which the human family originated, the few known fragments of the oldest fossil men are distributed geographically just as a palæontologist would expect them to be. The late Dr. W. D. Matthew pointed out that if each race of animals evolved at a single centre, a succession of waves of increasingly advanced genera must have radiated outwards from that centre. The latest and highest types would be found at the actual place of evolution, and they would be surrounded by rings of less advanced types of lower and lower degree until the lowest would occur at the outer limit.

The fragments of the oldest fossil men hitherto discovered are indeed very few, but although allowance for negative evidence may cause some hesitation, it is at least noteworthy that they are all on the periphery of the Euro-Asiatic continental area. *Eoanthropus* and Heidelberg man were found on the western margin of Europe, *Pithecanthropus* at the southern margin of Asia, and *Sinanthropus* close to the eastern coast of Asia. If human types were evolving near central Asia, the places of these actual discoveries are in a distant partial ring round the source.

The next stage in man's development is much better known, because by this time he had learned to bury his dead in security. As examples have been found in caves so far apart as France and Palestine, burial had doubtless become a general custom. Many whole skeletons are therefore available for study.

This stage is that of Neanderthal or Mousterian man, which is geologically the latest to retain several specially ape-like characters associated in a single individual. Its Asiatic origin is now still clearer to a palæontologist than that of earlier man. Burials in caves which seem to be approximately of the same date reveal a comparatively high Neanderthal type in Palestine, a low and bestial type in western Europe. On Matthew's principle already mentioned, the first is therefore nearest to the original source. The accompanying stone implements support this conclusion, for whereas in western Europe the implements are merely trimmed broad flakes, in Palestine there are also many narrow blades which resemble those made by later (Aurignacian) man in Europe. The Asiatic type of Neanderthal man was indeed progressing in skill to meet his increasing needs. He appears to show us modern man in the making.

Until typical *Homo sapiens* had come into being, man's only outlet from Asia seems to have been by land in the direction of Europe and Africa. As soon, however, as he had attained this final stage of development he must have been able to construct rafts or boats, by which he crossed the narrow seas of the East Indies to Australia, and perhaps the equally narrow seas at Bering Straits to North America.

Australia is shown by its past and present animal life to have been separated by sea from the rest of the world during the whole of the Tertiary era, including Pleistocene times, and it was isolated too early to be inhabited by the ancestors of the apes. Man is therefore certainly an immigrant from overseas, and we know that he reached the country when various relatively large Pleistocene marsupials were still living there, because a fossil human skull has been found at Talgai in Queensland directly associated with their remains. This skull is essentially the same as that of the existing Australian aborigines, who have retained a mode of life like that of the latest Palæolithic hunters of the mainland.

It is remarkable that very few traces of men who might be related to the ancestors of the Australians have hitherto been recognised in their homeland in Asia. The skulls of *Homo wadjakensis* from an old lake deposit at Wadjak in Java, discovered and described by Dr. Eugene Dubois, may perhaps be placed among them. The skulls named *Homo* (*Javanthropus*) *soloensis*, more recently discovered by Dr. W. F. F. Oppenoorth in an old deposit near the Solo river in Java, seem to be intermediate between the skulls of *Pithecanthropus* and the modern Australian, though they have not yet been described in detail. As many have observed, the skull of Rhodesian man (*Homo rhodesiensis*), from a cave in northern Rhodesia, also exhibits several resemblances to the skull of the modern Australian. Other skulls dug up in South Africa have also been described as exhibiting Australian characteristics. Sooner or later, therefore, fossil ancestral types of Australians will probably be found widely distributed in the tropics of the Old World.

In at least part of the first half of the Pleistocene period there must have been a direct connexion between Asia and North America in the region of Bering Straits. There may have been an isthmus of land, or there may have been only islands and continuous ice ; but there was certainly a passage which allowed such mammals as the mammoth, bison, sheep, goat, elk, wapiti, reindeer and black bear to reach America for the first time. So far, there is no evidence that man accompanied these animals, and it may be that by then he had not yet reached the north-east corner of Asia. The woolly rhinoceros similarly never passed from Asia to America, although it was abundant and widely spread through the northern lands in the Old World. Its absence from America shows that in come cases there were impediments to emigration.

The earliest traces of Palæolithic man hitherto discovered in North America date back only to the later part of the Pleistocene period. Last year, Mr. J. Dorsch, when collecting for Mr. Childs Frick, found at Fairbanks, Alaska, some small end-scrapers and conical cores, which Dr. N. C. Nelson recognised as identical with those which he had collected a few years before in large numbers in the Gobi desert. These seem to have been made by some of the latest Palæolithic men ; and the only stone implements hitherto found in North America in direct association with the remains of typically Pleistocene mammals show that, when man arrived in that country, he had already learned the supreme art of trimming stone by pressure-flaking. In pattern, indeed, his implements resemble those of Solutrean man in Europe, and even include the familiar Solutrean leaf-shaped blades, besides the characteristic spear points. They have lately been satisfactorily proved to be contemporaneous with extinct mammals of Pleistocene age in several localities, especially in New Mexico, Texas, Colorado, Nevada, and Nebraska.

Some of the typically Pleistocene mammals in the southern part of South America appear to have survived until comparatively recent times.

Man was almost certainly associated with them, but nothing is known to distinguish this race from modern South American Indians. The supposed ancestors of the human family reported by Florentino Ameghino from the Tertiary rocks of Argentina are due to erroneous interpretation of the fossils, as already pointed out by Hrdlička and others.

The first fossilised remains of man in the South American continent were discovered exactly a hundred years ago in the caves of Minas Geraes, Brazil, by the Danish naturalist, Dr. Peter Wilhelm Lund, whose centenary has just been celebrated by the scientific men of Brazil in Lagoa Santa and Bello Horizonte. Under the direction of Prof. Anibal Mattos, three volumes have been published in Bello Horizonte, giving an account of Lund's researches, with a Portuguese translation of his scientific papers.

Some years ago the late Dr. Francisco P. Moreno, Dr. Rudolf Hauthal and I, described the discovery of the dried skin and other remains of an extinct ground sloth (*Neomylodon* or *Grypotherium*), with fragments of other extinct mammals, in a cave in Last Hope Inlet, Patagonia. Here again, the presence of fires, cut and worked bone, and masses of hay cut for food for the ground sloth, led us to infer that man lived in Patagonia with the various Pleistocene mammals which are now extinct.

The races of men who eventually reached New Zealand and other remote islands were so far advanced in civilised life that they scarcely concern a palæontologist. They only interest him on account of the disturbance of the existing wild life and the extinctions which they have caused. The ethnologist now joins the human anatomist in attempting to explain the distribution of these people and to discover their relationships. They occupy a lowly sphere in the *modern* world.

The Meaning of Probability

By Dr. Herbert Dingle

THE subject of probability originated in the consideration of actual but trivial problems. Its obvious attractions as a field for the exercise of mathematical ingenuity soon gave it a predominantly mathematical aspect, and in spite of its application to certain practical activities such as those of insurance companies, and its significance for statistical mechanics, it has until recently been treated as a branch of pure mathematics. Nevertheless, the word has a meaning in ordinary life among those who never concern themselves with mathematics. Such people have often to act without sufficient knowledge to predict with certainty the effect of their actions, and they do so in accordance with the 'probabilities' of the case. They do not calculate a numerical magnitude; they simply act in the way which they feel to be 'most likely' to produce the result they desire. Obviously, it is desirable that the precise scientific definition of probability should approximate as closely as possible to the pre-existing, indefinite conception which directs the majority of our actions. If it does not do so, it is not necessarily illegitimate mathematically or even physically, but it would then be better represented by another word.

Now in recent years probability has entered physics in a much more vital way than previously. This introduces another complication. In order to obtain physical credentials, concepts have now to satisfy certain conditions which mathematics does not impose, and, as we shall see, probability in its customary mathematical sense does not necessarily satisfy those conditions. We have therefore a threefold aspect of probability—an ordinary, everyday aspect, a mathematical aspect and a physical aspect; and unless hopeless confusion is to result, we must either use the word only to represent a conception which is satisfactory from all three aspects, or, alternatively, restrict our application of any narrower conception we may employ to those fields to which it legitimately belongs.

We must notice, however, that even when we have done our best to be precise, the question necessarily retains some vagueness—for two reasons. In the first place, when one wishes to convert an indefinite into a precise conception, one has obviously a certain latitude of choice, just as there was a certain latitude of choice in selecting a particular 'unknown soldier' to represent the general war hero. This affects our attempt to frame a mathematical or physical definition agreeing with our everyday use of the word. In the second place, the very idea of probability, however precise it is made, has an intrinsic vagueness, since, unless it has the value 1 or 0 (speaking in terms of the ordinary mathematical definition), it cannot be inconsistent with any single experiment made

to test it. This affects our attempt to make the physical equivalent to the mathematical definition.

Both these difficulties are well illustrated by the problem which is the subject of discussion between Dr. T. E. Sterne and myself[1]. That problem is as follows: "If A and D each speaks the truth once in three times independently, and A says that D lies, what is the probability that D speaks the truth?" Let us consider first the relation of the mathematical to the everyday treatment of this problem; we will consider its relation to the physical treatment later.

We have here an event (D's remark) to which we want to assign the probability that it has a certain characteristic (truth). We have two independent pieces of information bearing on it: (1) statistics concerning D's statements; (2) a comment by A, whose character is known. The difference between Dr. Sterne and myself is that I regard these pieces of information as completely independent, so that any combination of them is purely artificial, whereas he puts them in the same class, obtains a probability by combining them, and claims that it is significant because it is unambiguous.

Now, as we have seen, there is no final proof one way or the other. I would say that a probability derived from either (1) or (2) by itself would be within the limits of ordinary conceptions —like taking two different victims of the Battle of the Marne for the unknown soldier—but that a probability derived from a combination of (1) and (2) would go outside those limits; it would correspond to the choice of, say, a Crimean warrior. The essential vagueness of the first kind prevents a rigid proof of this, but I can give examples to show where, as it seems to me, Dr. Sterne has been misled.

In combining (1) and (2), Dr. Sterne is combining data which have an obvious but inessential resemblance: they are both concerned with people's statements. But those statements are used in different ways. D's character gives us a statistical probability, but A's character, *in reference to the statement of D in question*, has no statistical aspect; the datum would be unaltered if D had never before spoken. In my review of Sir Arthur Eddington's book, "New Pathways in Science", which originated this discussion[2], I tried to make the two sources of data as distinct as possible by citing an analogous problem involving the 'statistical' and the 'cause-and-effect' probabilities of a horse's success in a race. Here the essence of the problem is the same—we have still two independent sets of data bearing on a particular event—but, the irrelevant superficial resemblance having been removed, it is clear that a combination of those data is quite artificial.

What one does in such problems is, it seems to me, to choose first which kind of data to trust, and ignore the other. A gambler, I imagine (I confess to inexperience in these matters), usually decides in favour of the horse that seems most likely to win, and ignores statistics of what has happened to such horses in the past. Another example may make the point even clearer. If Ohm's law has been experimentally verified 9,999 times out of 10,000, and P, who speaks the truth once in 10,000 times, says that it is true, what is the probability that it is false? My own opinion is that no one would pay any heed to the unspeakable P, but Dr. Sterne's method would give a probability $\frac{1}{2}$—that is, the law would be as likely to be false as true. In the problem of D's statement, I am convinced that if there were any hesitation in one's mind, it would be whether to put trust in A or D: it would have nothing to do with any combination of their testimony.

Let us, however, turn to the physical question, which is by far the more important. One of the chief features of modern physics is the conscious realisation and practice of the principle that no statement shall be accorded physical meaning unless it can be tested by physical experiment. It was on this ground that Einstein rejected the notion of absolute simultaneity of spatially separated events: since there is no physical means of determining absolutely if two such events are simultaneous, there is no meaning in calling them so. It was on the same ground that Heisenberg rejected the simultaneous evaluation of certain conjugate characteristics of a mechanical system: since there is no means of determining, for example, the precise momentum of the system at a definite position in space, there is no meaning in saying that the system has simultaneous position and momentum.

The essential vagueness of the second kind mentioned above therefore seems to rule out probability as a physical conception. If we state that the probability that a certain event will occur is $\frac{1}{3}$, then our statement cannot be checked by seeing if it does occur: whether it occurs or not, the statement may still be either true or false. Yet, in spite of this obvious disqualification, probability has stepped into the place vacated by conceptions which the principle in question has expelled. What is the explanation?

It is simply that probability in physics is purely symbolical: it is a metaphor expressing certain experimental results. For example, we find by experiment that in certain definite circumstances a screen is twice as brightly illuminated at one place, A, as at another, B. Now begins the metaphor. We imagine the light to consist of groups of 'photons', to which we assign the

property of illuminating the screen in proportion to their number; hence we must imagine that twice as many photons fall on A as on B. To enlarge our conception we ask why this is so, but we can get no answer. We must therefore rest content with saying that the 'probability' that a particular photon will go to A is twice as great as the probability that it will go to B. We cannot justify this physically if it is taken in any literal sense because, as we have seen, it cannot be tested. It has physical meaning only if we take it as a metaphorical expression of what we observe. We express the *observed behaviour of many* (arbitrarily imagined) photons by attaching a *hypothetical property to each* of them.

Let us now test the physical reality of the probabilities involved in our problem. The records of D's statements alone give a result (let us call it the 'probability'), $\frac{1}{3}$. A's comment alone gives a result (the 'likelihood'), $\frac{2}{3}$. Dr. Sterne's "association table" gives a result (the 'chance'), $\frac{1}{2}$. The probability and the likelihood are obviously real, for they symbolise the results of experiments which have been made. The chance, however, is in different case. It purports to mean, as Dr. Sterne himself says, that if A says many times that D lies, half of his comments will be true. But there is no experimental evidence for this, for the data do not tell us that A has made more than one such comment. We cannot, furthermore, make an experiment to test it (strictly speaking, a superfluous consideration, for 'chance' is intended to represent not prediction but existing fact), for even if we could bring A and D together, make D speak many times, and induce A to comment on each of his remarks, we could have no guarantee that the conditions would not violate the postulate—that, in fact, A and D would continue to speak truth or lie 'independently'. Hence 'chance' can have no physical significance, for it symbolises, not experimental results but a mathematical process.

The questions involved in this discussion are far more important than may appear on the surface. If the chapter on probability in Sir Arthur Eddington's book had been merely an account of a mathematical theory, it would, in spite of its interest and value, scarcely have called for lengthy controversy in a general scientific journal. It was included, however, because of the importance of probability in modern physical theory, and the reader would naturally suppose that what he was reading about had a physical application. This is a relatively harmless example of one of the most regrettable characteristics of our time. Probability, which enters physics as a symbol for expressing actual observations, emerges in scientific romances, amid the blare of trumpets, dressed as a general custodian of any sort of knowledge or rumour that may drift along, and purely objective systems are spoken of as 'waves of knowledge' or 'waves of probability', as though inorganic Nature is altered when someone speaks about it. The consequence is that the general public is led to believe that Nature is dissolved into pure subjectivity.

It is all the result of allowing mathematics, which is a good servant, to become a bad master. Instead of observation, the true test of physical reality, we are offered mathematical uniqueness. So insidious is this evil that Dr. Sterne appears to find it incredible that I describe as a "meaningless mathematical function" an expression which is immediately seen to be so by the foremost criterion of the physics in which he himself has done such brilliant work. It has even been suggested that mathematics is divine, when it is not even physical. It is much to be hoped that the true relations between mathematics and physics will be clarified, for the sake of both physical progress and general understanding of recent advances of thought.

D's statement	C's statement	B's statement	A's statement
		$C \rightarrow D + T$ 3	$B \rightarrow C \rightarrow D + T$ 1
			$B \leftarrow C \rightarrow D + L$ 2
	$D + T$ 9		$B \rightarrow C \leftarrow D + T$ 2
		$C \leftarrow D + L$ 6	$B \leftarrow C \leftarrow D + L$ 4
T 27			$B \rightarrow C \rightarrow D - T$ 2
		$C \rightarrow D - T$ 6	$B \leftarrow C \rightarrow D - L$ 4
	$D - L$ 18		$B \rightarrow C \leftarrow D - T$ 4
		$C \leftarrow D - L$ 12	$B \leftarrow C \leftarrow D - L$ 8
			$B \rightarrow C \rightarrow D - T$ 2
		$C \rightarrow D - T$ 6	$B \leftarrow C \rightarrow D - L$ 4
	$D - T$ 18		$B \rightarrow C \leftarrow D - T$ 4
		$C \leftarrow D - L$ 12	$B \leftarrow C \leftarrow D - L$ 8
L 54			$B \rightarrow C \rightarrow D + T$ 4
		$C \rightarrow D + T$ 12	$B \leftarrow C \rightarrow D + L$ 8
	$D + L$ 36		$B \rightarrow C \leftarrow D + T$ 8
		$C \leftarrow D + L$ 24	$B \leftarrow C \leftarrow D + L$ 16

If, after this, I may be allowed a word on the purely mathematical question, I would say that, if I have understood Dr. Sterne's contingency table aright, I do not agree with him that it cannot be constructed for Sir Arthur Eddington's original problem. If that were so, it would of course indicate a defect of his method of treatment, because the problem (if we allow the assumption, which must be made in the simplified problem as well as in this, that if D does not lie he necessarily speaks the truth) is unambiguous. I had, however, constructed what I believe to be such a table before his first letter appeared. It is given above.

81 statements by D are considered, and each remark in the table is followed by "T" or "L", representing "truth" or "lie", and by the number of such remarks in the 81 cases. For brevity, the following symbols have been adopted :

→ means "asserts that" ; + means "tells the truth";
← ,, "denies that" ; − ,, "lies".

It will be seen that only lines 6 and 10 of A's statements satisfy the conditions of the problem, giving 4 cases in which D lies to 4 in which he speaks the truth, so that the 'chance' that D speaks the truth is $\frac{1}{2}$, as in the simplified problem. (Incidentally, it will be noted that A lies every time he makes the statement in the problem, so that it would appear to be impossible for B to deny that C declares that D lies—further evidence of artificiality.)

The "likelihood" I calculate as follows :

The probability that A tells the truth is $\frac{1}{3}$. Hence the probability that B denies that C declares that D lies is $\frac{1}{3}$.

If B denies that C declares that D lies, the probability that his denial is false (that is, that C does declare that D lies) is $\frac{2}{3}$. Hence the absolute probability that C declares that D lies is $\frac{1}{3} \times \frac{2}{3} = \frac{2}{9}$.

If C *does* declare that D lies, the probability that D tells the truth is $\frac{2}{3}$. Hence the absolute probability (that is, the 'likelihood') that D tells the truth is $\frac{2}{9} \times \frac{2}{3} = \frac{4}{27}$.

The 'probability', of course, is $\frac{1}{3}$.

[1] NATURE, **135**, 451, 1073 ; 1935. **136**, 301, Aug. 24 ; 1935.
[2] NATURE, **135**, 451 ; 1935.

News and Views

British Association: Officers and Meetings

AT the meeting at Norwich of the General Committee of the British Association, Sir Josiah Stamp, General Treasurer of the Association, was elected president for 1936. Sir Josiah, who is chairman of the London Midland and Scottish Railway, was president in 1930–32 of the Royal Statistical Society and enjoys an international reputation as an economist. The office of General Treasurer of the Association has been filled by the election of Prof. P. G. H. Boswell, until now one of the General Secretaries. Prof. F. J. M. Stratton, the other General Secretary, decided not to offer himself for re-election, so it became necessary to appoint two new general secretaries. These offices have been filled by the election of Mr. F. T. Brooks, reader in mycology in the University of Cambridge, and Prof. Alan Ferguson, assistant professor of physics at Queen Mary College, London. The new members of council are Lord Bledisloe, Prof. W. G. Fearnsides, Prof. Julian S. Huxley, Prof. R. Robinson, Dr. C. Tierney and Sir Gilbert Walker. Future meetings of the Association are announced for Blackpool (1936), Nottingham (1937), Cambridge (1938), Dundee (1939) and Australia (1940) ; and it is suggested that a selected party be sent in the winter of 1937–38 to take part in the jubilee meeting of the Indian Science Congress.

A Darwin Commemoration

SECTION D (Zoology) of the British Association devoted the afternoon of September 6 to the commemoration of the centenary of the landing of Charles Darwin on the Galapagos Islands, and of the birth of the hypothesis of the "Origin of Species". He landed on September 16, 1835, and during the five weeks he spent in the archipelago his observations included those on birds and reptiles recorded in his note-book, as quoted by Mrs. Barlow in her letter published in NATURE of September 7, p. 391. The clear differences presented more especially by the finches and the giant tortoises found on the different islands, led Darwin to a highly important line of thought and to the realisation that his facts, if well founded, "would undermine the stability of species". In an introductory address, Sir Edward Poulton gave an outline of the observations made by Darwin on the fauna of the islands, as a result of which he became convinced that he must abandon the idea of the separate creation of species though he was then unable to account for their origin. Sir Edward then reviewed evolutionary thought during the past century, especially in relation to the theory of natural selection. Prof. J. H. Ashworth gave an account of Darwin as a student in Edinburgh from 1825 until 1827 with particular reference to the development of his early taste for natural history and collecting, and concluded that in Edinburgh Darwin laid the foundation of his knowledge of the science of natural history. Prof. G. D. H. Carpenter spoke on Darwin and entomology, and cited examples in support of the theory of natural selection. Prof. E. W. MacBride spoke on Darwin and the problem of the population of the Galapagos Islands, and expressed his dissent from Sir Edward Poulton's views on the value of natural selection as a cause of evolution. Mr. H. W. Parker gave an account of the present distribution of the reptiles in the Islands, pointed out that two of the species found by Darwin were extinct and the others by no means common, and that the danger of extinction of other species had been recently realised by the Government of Ecuador. We hope shortly to publish an account of this interesting commemoration.

Protection of the Galapagos Fauna

THE giant tortoises and large iguanid lizards, which are a noteworthy feature of the fauna of the Galapagos Islands, have been greatly reduced in numbers during the last hundred and fifty years on account of their value as a source of oil, meat and leather. Many species are already extinct, and the numbers of others have passed below that minimum limit beyond which a species is unlikely to recover. Their commercial importance has now largely disappeared, but a new factor has arisen which menaces not only the larger reptiles but also the whole fauna. Pigs, dogs, cats and rats, introduced by settlers and visiting ships, are rapidly multiplying and preying heavily on the indigenous population. The danger has been apparent for many years, but it is only recently that a group of American zoologists, associated with the American Committee for International Wild Life Protection, has prevailed upon the Government of Ecuador to enact legislation to protect the fauna. The British Association has expressed to the Government of Ecuador its deep appreciation of the action taken, and has instructed its representative at the forthcoming International Zoological Congress (Dr. W. T. Calman) to direct attention to the matter. Unfortunately, the full scope of the Ecuadorian decree is not at present known in England, but it seems that permission has been given for many of the islands to be set aside as Nature reserves, and for the protection of the native reptiles, birds and aquatic mammals throughout the entire archipelago. No provision appears to have been made for the enforcement of the decree, but it is hoped that an international committee may be formed to co-operate with the Government of Ecuador to achieve this end; Sir Edward Poulton and Mr. H. W. Parker having been nominated by the British Association as its representatives.

Science and Population Problems

SIR ARNOLD WILSON'S public lecture to members of the British Association and others delivered at Norwich on September 9, which dealt with "Science and Population Problems", was a striking illustration of the manner in which the Association may contribute to the discussion of current problems of public policy and government. On these occasions of general assembly of the members, a considered statement on broad lines reaches a wider audience than that to which it is immediately addressed, and in pointing out the bearing of the results of scientific research on the method of approach to a solution of difficulties of the day, it can help to mould public opinion on sane and enlightened lines. Thus, for example, Sir Arnold Wilson, although showing in the latter part of his address that he had in mind more particularly the practical measures dictated by scientific study for dealing with a stationary or falling population in Great Britain, indicated by his wide survey of the facts, so far as known, throughout the world, that population problems assume a different complexion when viewed as a whole. He restored the perspective, which has been lost in recent discussion owing to post-War developments, by reminding his hearers that if in certain countries a stationary or falling population is a menace, a vast proportion of the world population —in the East alone, at least one third—is in immediate or prospective danger of under-nourishment or even starvation through pressure of population and economic stress. This fact, which was patent before the War and was emphasised time and again by the late Prof. J. W. Gregory, has been allowed to fall into the background in the discussion of more insistent social and economic sectional problems. Its implications are no less grave than they were, and call as urgently as ever for consideration—possibly along the line of the scientific study of the distribution of commodities.

Further Exploration of Zimbabwe

NOTWITHSTANDING the general acceptance of the results of Miss Caton-Thompson's excavations in Rhodesia in 1929, a section of archæological opinion in South Africa still adheres to the view that the Zimbabwe are more ancient than was then shown, and the work of a people other than of Bantu stock. It will be remembered that when Miss Caton-Thompson submitted her results to the British Association, on behalf of which her excavations had been carried out, at the South African meeting in that year, Prof. Raymond Dart contested her conclusions, arguing for both the greater antiquity of the ruins and their lack of similarity to anything known in indigenous Bantu culture. An alternative suggestion is that they are of pre-Bantu origin, possibly the work of an Hamitic people under Arabian direction. Further research by South African archæologists, carried out after 1929, tends to confirm, rather than weaken, the view that structures of stone were not alien to early Bantu culture. Such, at least, is the origin attributed to ancient structures, which might, it is thought, have developed into the Zimbabwe, culminating in the unmortared granite towers and walls, thirty feet high and fifteen feet thick, of Great Zimbabwe. It is now reported from South Africa (*Observer*, September 6) that Prof. Dart, who has just returned to Johannesburg from Southern Rhodesia, proposes a further and more intensive exploration of Great Zimbabwe on a scale which will take five years for completion.

Romano-Celtic Temple at Colchester

FURTHER excavation on the Romano-British site at Colchester has revealed more fully the character and purpose of the remarkable enclosure and contained building discovered at Sheepen Farm on the banks of the Colne. The course of the northern wall has now been followed up, and the entire enclosure traced. It is found to be approximately rectangular in plan, except that the north-east corner has been deflected a distance of 155 ft., thus reducing the eastern face of the enclosure to a length of 180 ft. The total perimeter of the enclosing wall is roughly 511 yards. Further details of the enclosed building, of which the purpose is now evident, are given in a

report which appears in *The Times* of September 3. A stepped stone plinth, five feet square, in the centre of which there still remains *in situ* the base of a column of Purbeck marble, 1 ft. 3 in. in diameter, has been found approximately in the centre and in contact with the eastern face of the outer wall of the temple. The steps on the southern face of the plinth still retain portions of the original plaster, and on one fragment of the latter there are faint traces of colour. It is suggested that the column and plinth may be the surviving evidence of an altar which once faced the entrance of the temple. Flanking the plinth to the north and south, at approximately 11 ft. from the north-east and south-east corners of the outer wall respectively, are remains of packed rubble foundations, on which may have stood plinths of a similar nature to that which has been discovered facing the main entrance. At present, owing to their mutilated condition, and until further examination has been made, any conclusion would be premature. The drastic manner in which the temple was destroyed ultimately is, it is pointed out, indicated by the fact that only in the south-east corner of the wall of the *cella* does any portion of the original construction remain.

Funds for Archæological Exploration in Britain

Sir Frederic Kenyon, in his first presidential address to the Society of Antiquaries of London, which now appears in full in the *Antiquaries Journal*, **15**, 3, stresses the difficulties which beset archæological excavation in Great Britain through the lack of men and money. Of the two, he feels constrained, and rightly, to lay greater emphasis on the latter. Few archæological excavations, he points out, are, like Verulamium, able to 'live on the country' and rely for any considerable proportion of their cost on a constant stream of visitors. Probably most excavators would regard such a solution of their difficulties as something of a calamity, in view of the constant interruption of their work. In the report of the Council, appearing concurrently with the presidential address, an appeal is made for support for the Society's Research Fund, which at present is not adequate to permit subvention of local funds by any amount which is more than an expression of goodwill. The Society is also faced for some time to come with responsibility for the excavation of Maiden Castle at Dorchester. Archæological exploration on any considerable scale is an especially expensive form of scientific research, and is usually beyond local resources. Sir Frederic suggests that the difficulties of the present situation might be met by the formation of a central fund, administered by such a body as the Society of Antiquaries through the machinery of the Congress of Archæological Societies. If this suggestion were adopted, it need not interfere with local interest, but should rather serve to stimulate it. It would also help to co-ordinate archæological research—a matter of no little moment; but not the least advantage it offers is that it would facilitate prompt action when, in these days of rapid development for building, it might be urgently necessary immediately to follow up some chance discovery.

International Congress of Pre- and Protohistoric Sciences

The Second International Congress of Prehistoric and Protohistoric Sciences, in accordance with the decision taken in 1932 when the first session was held in London, will take place at Oslo in 1936. The Congress will meet early in August. Invitations and a preliminary statement are now being issued by the organising committee in Norway. The president will be Prof. A. W. Brøgger; and Juhs Bøe, Sigurd Grieg and Prof. J. L. Myres will act as general secretaries. The subscription has been fixed at 25 kr. for members and 12 kr. for associates. Enrolments and subscriptions should be addressed to the Bureau of the Congress, Universitetets Oldsaksamling, Oslo. Those who wish to contribute to the proceedings are requested to inform their national representative on the Conseil Permanent before March 1, 1936, and to forward an abstract of their communication to the organising committee before May next. The representatives of Great Britain on the Conseil Permanent are Prof. J. L. Myres, Sir Charles Peers and Prof. V. Gordon Childe (University of Edinburgh), and Mr. C. E. P. Hawkes (British Museum, Bloomsbury, London, W.C.1), secretaries. The organising committee announces that communications dealing with the topics which have been selected for discussion, as mentioned below, will be especially welcomed.

On broad lines the arrangement of the proceedings will follow that of the London congress, when the members met in five sections, dealing respectively with human palæontology and the evolution of prehistoric man, the stone and metal ages in the ancient world and as found elsewhere, and the transition from prehistoric to historic. Special attention will be given to the discussion of certain Scandinavian problems in relation to the prehistoric archæology of Europe and the ancient world at large. The topics proposed, which were approved by the Conseil Permanent at Berne in December last, are: the excavations on stone age sites in Finmark of the last ten years, rock engravings in Norway and elsewhere, the Iron Age farms of Norway, the history of Teutonic art forms in the fifth and sixth centuries, and the textiles of Oseberg. It is possible that the domestic animals of prehistoric times and the origin of the runic alphabet may also be included, but this question has yet to be decided. The organising committee is anxious that problems arising out of these subjects should be discussed as thoroughly as possible on broad lines.

Co-operative Buying

It is now generally recognised in large-scale business that considerable economies can be obtained through the establishment of a central purchasing department, and in the Second Report of the Committee on the Standardisation and Simplification of the Requirements of Local Authorities (H.M. Stationery Office. 6*d*. net), a similar policy is urged on local authorities. The larger local authorities are recommended to co-ordinate the buying of their various departments while smaller authorities are advised to co-operate with other

similar authorities or with larger neighbours. Co-ordinated or co-operative buying is, however, of much reduced value if it is not preceded or accompanied by a fair measure of standardisation and simplification whereby unnecessary variations of type, size and quality can be eliminated. Already the County Councils of Kent, London and the West Riding of Yorkshire have adopted complete centralisation of the buying functions in a supplies department which is independent of other departments ; while the City Councils of Birmingham, Liverpool and Manchester have partially centralised the buying functions in those departments which are the largest users of the particular commodity. Manchester City Council saved £17,000 in 1933–34 by determining the best grade of fuel for the heating apparatus at its institutions (thereby halving the number of grades in use), and buying its fuel in bulk and by specification. The Committee strongly emphasises the point that bulk purchase if it is accompanied by standardisation and simplification enables better goods to be bought with less money, but that bulk purchase cannot be operated with maximum success unless the requirements of the buying unit are large enough to command large-scale buyers' terms and to employ experienced staff.

Influence of Industrialism on Mortality in Japan

In a recent report of the Institute of the Science of Labour, Kurasiki, Japan (No. 29 : (1) Sex-Ratio in the Population of Japan Proper ; (2) The Influence of Industrialism upon the Mortality of Young People and Adults. By Dr. Sinzi Katuki. Pp. 30. Kurasiki : Institute for Science of Labour, 1935. 60 sen), Dr. Sinzi Katuki writing on the influence of industrialism upon the mortality of young people and adults shows that there is in Japan a close correlation between the female death rate in the age group 15–44 years and the rate of migration from the rural to the industrial areas. The death rate among women workers exceeds that of males in every industry except mining. Dr. Katuki concludes that these facts suggest the grave responsibility of industry for the heavy death rate of Japanese girls and young women, since in Europe and America, although employment of women is extensive, the female death rates are much lower than in Japan, absolutely and relatively to the male death rates. It would therefore seem that the high death rate of Japanese women in this age group is the result not of industrial labour in itself but of the bad conditions under which it is carried on and the insufficient protection of female workers. Recent statistics show a remarkable increase in the industrial occupations of women in Japan. Whereas formerly the great majority of women engaged in industrial employment regarded it merely as preparatory to marriage or only as a subsidiary means of subsistence, it has now frequently become their permanent and essential means of livelihood.

Synchronisation of Radio Stations

The effect produced when a wireless set receives two different programmes on the same wave-length, although the stations may be widely apart, is sometimes called 'radio hash' in the United States. The Federal Communications Commission spaces two stations producing the same wave-length as widely apart as possible, but according to a report issued by Science Service, Washington, D.C., the whole country is spotted with these 'hash' or interference areas. In the June number of *Electronics*, the editor of which, Dr. C. H. Caldwell, was formerly a radio commissioner, a method of synchronising several stations on a given wave-length is described and thus space could be saved in the broadcasting spectrum. If the plan were carried out, no less than 1,527 radio stations could be constantly working in the present 106 channels. If all the stations, on a great nation-wide 'chain programme', broadcast only on three adjoining channels, 750, 760 and 770 kilocycles, for example, then it is only necessary to turn on one of these to get the corresponding programme. If one turns to other wave-lengths, then other chain programmes are obtained. In addition, low-powered stations, one kilowatt, for example, could be working —twelve to a broadcast channel—throughout the country. These programmes would be sharply differentiated from the 'chains'. Ten channels would be allotted to Canada, Mexico and Cuba, all of whom are asking for more space on the ether. For the American farmers there would be seven channels for superstations up to 2,000 kilowatts, so that every farmer, however remote, could hear. The 1,500 new stations could be heard with less interference than the few hundreds they would displace.

Express Highways in Germany

Good progress is being made in the construction of express highways (*autobahnen*) in Germany. An article in *Roads and Streets* gives an illustrated description of some of these highways and incidentally gives a photograph of part of an old Germanic plank road, built about 1000 B.C. and excavated a year ago at Bremen. The first 1,000 miles of the express highway has been completed. Most of it consists of a lawn strip 15 feet wide bordered by traffic lanes 25 feet wide on each side, the sides of the whole road having 'shoulders' sloping upwards. Trees and shrubbery are planted on the centre strip and on the shoulders. The shrubbery in the centre strip protects the driver largely from the glaring headlights of cars travelling in the opposite direction. Densely wooded areas are relieved at intervals by small clearings giving views of distant landscapes. There are no crossings, viaducts or subways being provided so as to permit continuous and fast travel. Twelve of the German universities have laboratories for testing road building material. At Braunschweig there is a test track about 1,000 feet in diameter where tests are carried out on different types of surfaces under traffic conditions. The effects of the velocities of the vehicles on different types of tyres and the abrasion of the roads are all studied practically. The testing of materials for the eastern section of Germany, which is separated from the rest of Germany by the Polish Corridor, is done in the Free City of Danzig. It is hoped that the political difficulties which this Corridor will present to through traffic will soon be overcome.

Scientific Research in U.S.A.

In his report for 1933, the president of the Carnegie Institution of Washington has directed attention to the difficulties which beset scientific research during periods of political uncertainty and retrenchment. "Periods of emergency give rise to shifting conditions which may tend to press toward extinction of research and research institutions through financial weakening, and because of emphasis on what may be considered essentials of life." But on the other hand, emergencies present tests of adequacy in research as a method and of the human value of specific ideas for the origin of which it is responsible. The president says it is difficult to visualise a situation in which we could retreat from the present position. "The needs of civilisation can never be met by a static condition in which the generations merely settle down to life at a particular level. One can assume that through coming ages the requirement for increased knowledge with new ideas and their bettered application will grow. Unusual constructive ability arising out of what is known as the scientific interpretation will have an increasingly important part in development and organization of society. The investigation process, both as a means of securing ideas and as a method for learning their application, will naturally and properly take its place as one of the most nearly indispensable of all activities upon which the future well-being of mankind depends."

Cave Exploration

Now that the formation of a central body devoted to spelæological research in Great Britain holds out the prospect of a more systematic promotion of this branch of scientific studies, it is interesting to note the progress made in other countries towards the attainment of a like object. An article by M. R. de Joly, president of the Spéléo-Club de France, in *La Nature* of August 1 rapidly surveys recent activities in cave exploration, but touches in greater detail on the explorations in France of his own organisation. The Spéléo-Club de France was founded so recently as 1930, largely through the enthusiasm of M. E. A. de Martel; but already its members have explored or visited no less than six hundred caves, mostly in the Basses-Alpes, and some presenting considerable difficulties of penetration and no little risk to the explorers. One of the most remarkable feats of cave exploration to which M. de Joly refers was that of the great cave at the foot of the Guadalupe Hills, New Mexico—an area of which the cave exploration is now attracting no little attention in archæological circles in the United States in connexion with the association there of early man with a fauna now extinct. The cave of which M. de Joly writes, although discovered in 1901, was not systematically attacked until 1930, when a subvention from the *New York Times* made possible the organisation of an expedition of fifteen members to spend a fortnight underground. Notwithstanding difficulties of passage, no less than 51 km. were covered, including many chambers of enormous size. Another country which displays great activity in cave exploration is Italy, thanks to official financial support and the enthusiasm and friendly rivalry of a large number of local societies. Three thousand caves have been recorded as explored; and the Italians also hold the record for depth of descent. The Italian caves, indeed, are the deepest known, twelve being more than 250 m. deep, and four more than 300 m., while the deepest of all, the Bus della Preta, near Verona, has a depth of 620 m.

The Rabbit Menace

Wild rabbits have become so numerous in many parts of England that considerable alarm has been expressed by farmers and in the public press at the damage done to crops, pastures and young trees. The University of London Animal Welfare Society has for some years made a special study of the subject. It has now taken a useful and timely step in reprinting in Great Britain, by permission of the New South Wales authorities, a brochure entitled "The Rabbit Menace in Australia in 1933 and the Way Out", by David G. Stead, formerly special rabbit menace commissioner to the Government of New South Wales. The booklet brings strong confirmation to the views previously promulgated by the Society to the effect that the wild rabbit, considered as stock, does not pay, since the damage done by it far exceeds the price received by the farmer; that the trapping industry increases the stock of rabbits instead of diminishing it, and that control of the rabbit-population can be most efficiently (as well as most humanely) carried out by the use of calcium cyanide or similar products yielding hydrocyanic acid gas. The Society has issued several other publications on the subject of rabbit-control.

Treatment of Anæmias

We have received from Boots Pure Drug Co., Ltd., Nottingham, an illustrated booklet describing the different products issued by this firm for the treatment of the anæmias. 'Pepsac' is an active preparation of desiccated hog's stomach, which is given by mouth in pernicious anæmia: 'Hepostab' is an extract of liver specially prepared for intramuscular injection. It is suggested that treatment be commenced with 'Hepostab', especially if the case is a severe one, and continued from the fourth day onwards with 'Pepsac'. Each batch of 'Hepostab' is subjected to clinical trial before issue. Both preparations, and especially 'Pepsac', are of great value in the treatment of subacute combined degeneration of the spinal cord, the most severe complication of pernicious anæmia. Messrs. Boots also prepare liver extracts for oral administration, namely, compound fluid extract of liver—Boots, liquid extract of liver B.P., and dry extract of liver—Boots. For the treatment of secondary anæmias, 'Livron' is recommended: this is an extract of liver, yeast and malt with the addition of a full therapeutic dose of iron.

Medical Research in Egypt

We have received the third annual report of the Research Institute and the Endemic Diseases

Hospital, Cairo, for the year 1933. This shows that, under the directorship of Dr. M. Khalil Bey, much valuable work is being done on the endemic diseases and epidemiology of Egypt. One of the most interesting announcements is the discovery of the intermediate host of a human trematode or 'fluke' parasite, *Heterophyes heterophyes*, first discovered in 1851. The second intermediate host is a fish, in which the cysts of the metacercariæ were found in 1923, and from eating which human infection is derived. The first intermediate host has now been determined, and proves to be a fresh-water snail, *Pirenella conica*, which was found to be infected with the cercariæ of the parasite, and by eating this infected snail the fish become infected.

Lectures on the Rothamsted Experiments

DURING the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, and other members of the staff are prepared to give lectures to chambers of agriculture and horticulture, agricultural societies, etc., on the Rothamsted experiments. No fee will be charged for the lecturers' services but any association engaging them will be expected to defray their travelling and hotel expenses and to make such arrangements for the lecturers as may be necessary. The following topics are offered by the member of staff indicated: soil micro-organisms (Dr. H. G. Thornton, Dr. Hugh Nicol and Mr. D. W. Cutler), agricultural botany (Dr. Winifred Brenchley), agricultural chemistry (Dr. E. M. Crowther and Dr. H. L. Richardson), soil physics (Dr. B. A. Keen and Dr. R. K. Schofield), entomology (Dr. C. B. Williams, Dr. H. F. Barnes and Mr. D. M. T. Morland), plant pathology (Dr. J. Henderson Smith, Miss M. D. Glynne and Mr. Geoffrey Samuel), fertilisers, manures, etc. (Mr. H. V. Garner). Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

Announcements

THE late Prof. Ramon y Cajal has left a legacy of 25,000 pesetas to the Spanish Academy of Medicine to found a prize for the best work on a subject to be selected by the Academy.

THE Rockefeller Foundation has made the University of Chicago a donation of 243,000 dollars, of which 168,000 are to be spent on the foundation of a psychiatric clinic.

THE following appointments have been made by the Secretary of State for the Colonies: Mr. J. H. Harris, to be assistant chemist, Geological Survey, Tanganyika; Mr. C. W. S. Hartley, to be agricultural officer, Malaya; Mr. G. B. Masefield, to be agricultural officer, Uganda; Mr. A. F. McKenzie, to be agricultural officer, Sierra Leone; Mr. R. F. A. L. Reed, to be superintendent of agriculture, Nigeria; Mr. W. T. Dalgarno, agricultural instructor, Bahamas, to be superintendent of agriculture, Nigeria; and Mr. E. Williams, superintendent of agriculture, Gambia, to be agricultural officer, Uganda.

THE annual exhibition of the Royal Photographic Society will be formally opened by the president, Mr. Robert Chalmers, on September 13. The exhibition will be open to the public in the Society's galleries, 35, Russell Square, W.C.1, on September 14–October 12, from 10 a.m. until 9 p.m. (Sundays excepted), except Tuesdays and Fridays when it will be closed at 6 p.m., and lectures given. Admission to the exhibition is free.

THE twenty-second Congress of the Alliance of Social Hygiene will be held in Angers on October 4–6, when the following subjects among others will be discussed: Social medicine and traditional family medicine, extension of the work of social hygiene in rural areas, social value of open-air sports, anti-cancer and anti-venereal disease centres, the campaign against tuberculosis, old-age assistance and the declining birth-rate. Further information can be obtained from Prof. C. Metzger, 36 Boulevard Ayrault, Angers.

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

An assistant director of works in the Egyptian Irrigation Service in the Sudan—The Chief Inspecting Engineer, Egyptian Government, 41, Tothill Street, London, S.W.1 (Sept. 16).

A head of the Mechanical Engineering Department of the School of Engineering and Navigation, High Street, Poplar, E.14—The Education Officer (T.1), County Hall, S.E.1 (Sept. 16).

An examiner in the Aeronautical Inspection Directorate—The Secretary (S.2.d.), Air Ministry, Kingsway, W.2 (Sept. 19).

A head of the Chemistry and Natural Science Department and Vice-Principal of the Portsmouth Municipal College—The Registrar (Sept. 21).

A research assistant in physics in the University of Leeds—The Registrar (Sept. 23).

An advisory economist in the Seale-Hayne Agricultural College, Newton Abbot, Devon—The Principal (Sept. 25).

An assistant lecturer in mathematics in the Royal College of Science—The Secretary, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W.7 (Oct. 1).

Two assistants in cancer research—The Secretary, British Empire Cancer Campaign, 12 Grosvenor Crescent, London, S.W.1.

A lecturer in structural engineering and mechanics in the Borough Polytechnic, Borough Road, London, S.E.1—The Principal.

Part-time lecturers in automobile engineering, theory, practice, drawing and design in the Polytechnic, Regent Street, W.1—The Director.

An assistant lecturer and demonstrator in the Faraday House Electrical Engineering College—The Principal, Faraday House, W.C.1.

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. 439.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Age of the Universe

ONE of the most important problems of present-day astronomy is that of the age of the universe, and one of the most important pieces of evidence is provided by the orbits of binary stars. The ages which need to be seriously considered fall into two groups; the first is that of the so-called 'long' time scale, which is of the order of 10^{13} years, the time the stars would need to have reached their present condition by annihilation of their substance; the second is that of the 'short' time scale—which is of the order of 10^{10} or 10^{11} years, the time needed for the universe to have expanded from small beginnings to its present size. The motions of the stars ought to provide a means of deciding between the two. For dynamical discussion shows that with the long time scale both the linear motions of single stars and the orbital motions of visual binaries ought to show a reasonably good approximation to equipartition of energy; the short time scale, on the other hand, gives nothing like enough time for such an approximation to be established. Thus if the motions of the stars are found to show any marked approximation to equipartition of energy, it is exceedingly difficult to do other than decide in favour of the long time scale.

It is not easy to test the linear motions of the stars for equipartition of energy, for this requires a knowledge of stellar masses, and these are very imperfectly known. Nevertheless, so far back as 1922, Seares found that the linear motions of the stars show a tolerable approximation to equipartition of energy. It is far easier to test the orbital motions, since I have shown that if these conform to the law of equipartition, the number of orbits whose eccentricity is less than e will be proportional simply to e^2. The material collected in the recent new edition of Prof. Aitken's book "The Binary Stars" makes it possible to test this requirement with some accuracy. The agreement with the equipartition law is shown in the following table:

Orbits of Visual Binaries classified by Eccentricity

Limit of e	Observed	Equipartition
$e < 0{\cdot}1$	0	2
$e < 0{\cdot}2$	11	9
$e < 0{\cdot}3$	20	21
$e < 0{\cdot}4$	34	37
$e < 0{\cdot}5$	58	58
$e < 0{\cdot}6$	83	83
$e < 0{\cdot}7$	89	113
$e < 0{\cdot}8$	102	148
$e < 0{\cdot}9$	109	187
$e < 1{\cdot}0$	116	231

In the last column, the total number of stars has been taken to be 231, so as to make the number of orbits of eccentricity less than 0·6 equal to the number actually observed.

Inspection of the table now shows that up to this eccentricity, observation agrees well with the predictions of the law of equipartition; above it there is a marked deficiency of observed orbits. This deficiency can readily be explained by the well-known difficulty of detecting binaries of high eccentricity, and the still greater difficulty of measuring the elements of their orbits with sufficient certainty to justify their inclusion in a catalogue.

The agreement seems to me far too good to be accidental, so that the new material collected by Prof. Aitken would seem to provide strong evidence in favour of the long time scale.

Dorking.
Aug. 31.

J. H. JEANS.

Blood Group Inheritance

FFOULKES EDWARDS and Etherington[1] put forward a theory of blood-group inheritance which amounts to the postulation, in addition to Bernstein's three allelomorphic genes causing the presence of one agglutinogen A or B or neither of them, of a fourth allelomorph producing both. This is intended to account "for the observed occurrence of a small percentage of groups AB and O in the offspring of $AB \times O$ matings".

Now supposing such occurrences to be inexplicable by "mistaken parentage or faulty technique" which the authors invoke in other exceptional cases, they might still be explicable by trisomy or by mutation. If AB individuals from such matings are much commoner than A or B individuals from $O \times O$ matings, the mutation hypothesis must be rejected. On the hypothesis of trisomy, the anomalous AB individuals have three chromosomes carrying the A, B and R genes, instead of the normal two. Such trisomy has, of course, been observed both in plants and animals.

The new theory may readily be tested. In the first place, no $AB \times O$ or $O \times AB$ mating should ever give more than two types of offspring, whereas on the hypothesis of crossing-over all four types might be expected. Secondly, an anomalous AB individual from such a mating should give only AB and O children when mated to a member of group O. On the hypothesis of trisomy, about two thirds of the offspring in such families should belong to groups A or B.

Similarly, the hypothesis of trisomy could be tested by Chrustschoff's[2] technique of observing mitoses in leucocyte cultures. Until one or both of these tests has been applied, it would seem that a suspension of judgment is desirable, Bernstein's theory being retained with the proviso that it may ultimately need modification.

University College,
London, W.C.1.
Aug. 30.

J. B. S. HALDANE.

[1] NATURE, **136**, 297, Aug. 24, 1935.
[2] Chrustschoff, *J. Genet.*, **31**, 243; 1935.

Metaphysics of the Physical World

RECENT letters to NATURE commenting upon Prof. Dingle's analysis of the Georgian era in physics express different views on the ultimate status of the physical world. The following discussion offers a foundation upon which all philosophers of science can agree. Philosophical differences arise if one seeks a deeper interpretation of the fundamental principles.

Prof. Dingle has shown that the new physics has been guided by a principle of observability: only those concepts that can be exemplified in observation are to be admitted in physical theory. The philosophical theory of logical positivism also employs the foregoing principle in the form of an empiricist criterion of meaning. The basic theory of the present discussion will conform to this principle.

The physical world consists of tables, chairs and other perceptible things. A thing is something of which aspects are given in perception. An aspect is an immediate datum of experience, for example, the visual aspect of a desk. Initially, the aspects of things are characterised by the fact that they can be given vividly in experience, but a more complete analysis reveals aspects to be functionally related to other aspects. Thus perception involves the vivid experience of aspects and the remembrance and anticipation of correlated aspects of a thing. Accordingly, our first principle concerning the physical world is that some physical things exist to which correlated sets of aspects belong which may be given in experience. The second principle is that the structure of things is exhibited in the structure of their aspects. These two principles suffice for a basic theory of the physical world. It is not possible to question the principles, since they are empirically discernible in the procedure of science.

It would accord with a positivist or empiricist philosophy to rest content with the foregoing principles. But traditional theory of knowledge, or epistemology, considers the ultimate relation between a thing and its aspects and their dependence on experience, and consequently yields a metaphysical theory.

The theory which has been favoured traditionally by natural scientific workers is dualism. The physical thing is assumed to be independent of experience and to produce its aspects by acting upon the observer. That aspects belong to a thing means that they are caused by the thing. Since the structure of an effect is determined by that of its cause, the structure of aspects manifests that of things. In contemporary discussion, dualism is sponsored by Sir Arthur Eddington.

Dualism was developed in the seventeenth century by Descartes and Locke. The empiricist criticism of it by Berkeley and Hume yielded subjectivism and phenomenalism. A thing was declared to be the set of its aspects which were assumed to be dependent on experience. Aspects belong to a thing in the sense of being members of the set of aspects constituting the thing; obviously, the structure of aspects exhibits the structure of things. The independence of things of experience is lost, and hence subjectivism and phenomenalism have been rejected by most philosophers.

In recent years, philosophers have made heroic efforts to work out a theory according to which experience directly presents an independent thing. The neo-realists, for example, have conceived of a thing as a set of aspects which are independent of experience. They thereby seek to retain the advantages of phenomenalism and dualism.

The three theories, dualism, phenomenalism and neo-realism, yield interpretations of the principles that the aspects of a thing belong to it and that the structure of things is exhibited in the structure of aspects. On dualism the two principles are hypotheses, on the two theories which assume direct experience of things the principles are definitions of a thing in terms of its aspects. It is impossible to decide empirically between the several theories, and on this ground the logical positivists would deny meaning to the problem and its solutions.

A position intermediate between the positivist theory which is expressed in our two fundamental principles and the several metaphysical views may be derived from Mach. The essence of a thing is the functional relation between its aspects. This functional relation is the independent feature of the physical things given in experience; the independent reality of the physical world resides in the independence of a system of laws rather than in the independence of substance. Whether one further holds with phenomenalism that aspects are created in experience, or with realism that aspects are merely revealed in experience, seems to be unimportant in that the issue cannot be decided empirically.

V. F. LENZEN.

Department of Physics,
University of California,
Berkeley.
July 31.

A Useful Application of the Principle of Heterogonic Growth

I HAVE come upon an interesting example of the way in which the application of the principle of heterogonic growth may simplify an involved problem. A certain measurement y of an organ or part of an organism is said to show heterogonic growth with respect to some standard measurement x of the organism when the equation $y = bx^k$ holds good over a definite period, b and k being constants typical for each particular case[1]. Heterogonic growth clearly involves a regularly continuous change of proportions.

This example concerns a well-known and widely-discussed study by the late Prof. Weldon on the shore crab, *Carcinus mœnas*[2]. In three different years, 1893, 1895, 1898, he made accurate measurements of frontal width (between the two most anterior 'teeth' on the anterior edge of the carapace) and carapace length, in a large number of young males covering the range 10–15 mm. carapace length, taken from a particular patch of beach in Plymouth Sound. Grouping the data by intervals of 0·2 mm. carapace length, he observed that with increasing size the mean relative frontal width became smaller, and concluded that some selective agency was acting against individuals with a relatively wide frontal aperture, the intensity of selection being assumed to increase with growth. The theory was apparently supported by the asymmetrical curves of distribution of individuals in each group. In the years 1895 and 1898 the frontal width was progressively less at the lowest size and its relative diminution with increase in body size was correspondingly more marked. Selection was assumed to have produced a progressive

change in the average initial proportions of the offspring and, in addition, the intensity of selection was increasing year by year.

This led Prof. Weldon to suspect that silt in the Sound, which was increasing steadily since the building of the breakwater, was the selective factor, and this he claimed to prove by laboratory experiments; crabs with relatively wide frontal apertures died, their gills covered with silt. Apparently an excellent example of effective selection in Nature, it has already been criticised on various scores by the late Mr. J. T. Cunningham[3] and others.

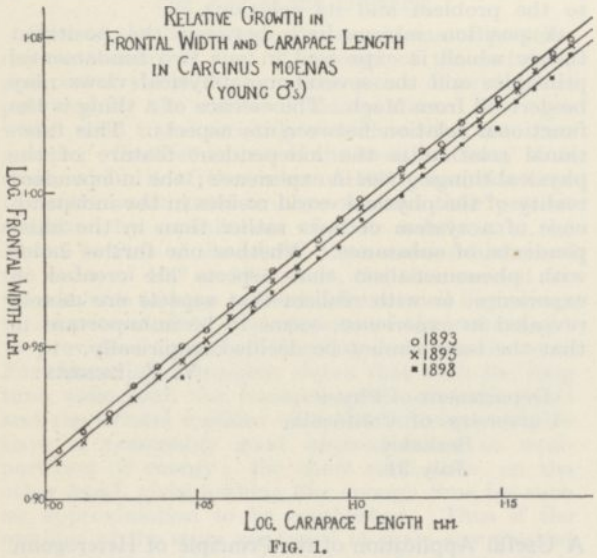

Fig. 1.

Now when the figures are plotted double-logarithmically, frontal width against carapace length, they give a straight line indicating heterogonic growth. The change of proportions which accompanies growth therefore occurs in every individual and automatically, not merely in the group-average, as a result of natural selection. The increase, with growth, of the annual differences, is similarly automatic, given the initial differences in proportion (measured by the constant b). The graphs for the three years are three parallel straight lines (Fig. 1), indicating identical heterogonic growth with a constant growth-coefficient, ($k = 0{\cdot}8$).

The constant b is the only quantity responsible for the differences between different years. However, data are required for more than three years to show whether or not its diminution is continuing. In any event, an explanation is required of its variability. This may be the effect of a variable external condition acting on early development, or even earlier, on the egg, through the parents. Analysis on the basis of heterogony has clarified and narrowed down the problem. In conclusion, it is of interest that young females differ from young males of the same year (1893)[4], but only in the constant b.

A. E. Needham.

Department of Zoology and
Comparative Anatomy,
University Museum,
Oxford.

[1] J. S. Huxley, "Problems of Relative Growth", London, 1932.
[2] W. F. R. Weldon, Section D, *Brit. Ass. Rep.*, Bristol, 1898.
[3] J. T. Cunningham, "Modern Biology", 1928.
[4] W. F. R. Weldon, *Proc. Roy. Soc.*, **57**; 1894.

Incidence of Rickets in Rabbits

In the Medical Research Council's Monograph "Vitamins: A Survey of Present Knowledge" (1932) it is pointed out that in Nature, rickets in rabbits is probably unknown, but can be easily produced under laboratory conditions. Furthermore, we can state that under normal conditions of management, the ordinary tame rabbit, as kept in hutches, is also free from the disorder. At this centre, about two thousand or more tame rabbits have been bred, and only three cases of rickets have been seen in the normal stock in nine years; two were in large varieties and one in a medium.

During the years 1927–29, importations of a new class of rabbit, namely, the 'Rex', with fur like the mole and which behaves as a recessive to normal fur, was imported from France and Germany, and this Institute purchased one Castorrex male and a trio of F_1 generation from Rex crossed normal coated stock, all from the same breeder. From the progeny of these animals, a number of rachitic animals appeared. Intensive breeding methods were followed in experimental fur production[1]. The male Rex was mated to normal coated does in May and June, 1929, and from 10 litters, 38 F_1 were grown to adults, from which 9 male and 19 female F_1 were selected for inter-breeding, and from February 1930 until September 1931, produced 524 F_2, in addition to certain other youngsters.

Of the F_2 generation, approximately one per cent of the *rex coated* rabbits had badly malformed forelegs, the condition resembling severe rickets, one *or* both forelegs being convex (bowed), whilst others, less severely affected, had one *or* both forelegs concave (knock-kneed). Closer examination showed some slight abnormality in a few of the normal-coated animals, but in no instance were these more than slight defects. Afterwards some adults were killed for post-mortem examination in the Veterinary Laboratory, and the severe cases confirmed as rickets, whilst a slight case was not confirmed.

Examination of the breeding records showed that rachitic animals occurred mainly in the fourth and subsequent litters, and that the disorder occurred mainly in large families. The average number of young for normal litters was 6·3, for litters in which concave forelegs appeared, 6·9, and for litters containing convex forelegs, 7·4. There was, however, one litter of one with the right foreleg pronouncedly convex. Of 99 F_2 examined for abnormal forelegs there were 79 normal furred and 20 rex furred, of which 10 normal furred (6 were slight cases) and 3 rex coated were concave; and, 3 normal and 9 rex were convex, which is a ratio of 2·96 normal legged to 1 abnormal (rachitic). Other breeders of rex coated rabbits also reported somewhat similar cases of rickets in rex coated but not in normal coated stock. It was, therefore, decided to investigate the possible inheritance of the rachitic condition to see whether it behaved, as indicated, as a simple Mendelian recessive character. However, attempted matings of rachitic with rachitic indicated absence of sexual desire, and in no case would severely rachitic animals copulate with one another.

W. King Wilson.

National Institute of Poultry Husbandry,
Newport, Shropshire.
Aug. 9.

[1] "Rex-Furred Rabbits", Bull. 73, Ministry of Agriculture, 1934.

Ascorbic Acid (Vitamin C) and the Germination and Growth of Seedlings

SCARCELY anything is known regarding the phyto-biological role of vitamin C in the life of the higher plants, and so far as I am aware, no attempt has been made to investigate experimentally their responses when treated with this substance.

The experiments outlined in this note involved the examination of some 2,500 seeds and seedlings. The seeds were germinated on filter paper in Petri dishes, and both these and the seeds were sterilised. The ascorbic acid was dissolved in sterilised distilled water and 3–5 c.c. of this solution was added daily to each Petri dish containing 40–50 seeds. The filter-paper of the controls was moistened with the same quantity of sterilised distilled water. No nutrient substance was supplied, and the experiments were concluded when the reserves of the seeds were exhausted (generally in 12–13 days). The average total amounts of ascorbic acid supplied during this period were, for the different concentrations used, namely, 1/10,000, 5/10,000, 2·5/1,000 and 5/1,000, 4 mgm., 20 mgm., 95 mgm., and 150 mgm.

The observed effects on wheat were as follow. With concentrations of 1/10,000 and 5/10,000: no stimulation of germination, but an acceleration of growth and an increase of 25–30 per cent in the length of the shoots. At the end of the experiments, the weight of the shoots of the treated plants—as compared with the controls—showed an increase of 25–30 per cent and that of the roots an increase up to 50 per cent. A concentration of 2·5/1,000 exercised a slight inhibitory effect upon germination and a very marked one (24–45 per cent) upon the growth and weight of the seedlings. The concentration of 5/1,000 proved to be practically lethal.

Oats were much less sensitive both as regards the stimulatory and the inhibitory effects of ascorbic acid. On the other hand, it was noticed that upon seedlings of plants—such as tomato and paprika—which have naturally a high vitamin C content, a concentration of 5/10,000 was enough to exercise inhibitory effects.

Adult tomato plants treated with a 1/10,000 concentration of ascorbic acid showed no acceleration of growth and flowering, but although the number of fruits produced was less than in the controls, their total weight was 20 per cent greater.

Titration of the vitamin C content of the treated seedlings and tomato plants revealed no increase as compared with the controls.

LÁSZLÓ HAVAS.
Hungarian Biological Research Institute,
Tihany, Hungary.
Aug. 8.

Swarming of *Vorticella*

WE have observed a phenomenon of swarming in two common species of gregarious vorticellids which has apparently not been recorded hitherto.

Vorticella campanula is found living in crowded groups on pond weed. In an aquarium, the whole population of a group will leave their stalks almost simultaneously and become free-swimming. They do not disperse, but remain for an hour or two suspended from the weed in thread-like swarms. Fig. 1 is a photograph (half natural size) showing three such threads. One of the threads is seen to have a triple base: it arose by the fusion of three threads brought into contact by water movements. Each thread has a mucous core which is collectively secreted by the swarmers, each individual contributing its own mucous strand to the thread. The swarmers, after swimming actively for a time—some very close to the thread, some actually within it—finally settle down again in groups on solid objects.

We have observed this swarming many times, not only in *V. campanula*, but also in another gregarious form, *V. chlorostigma*. Usually, in the latter, the swimming animals collectively form a globular cloud, like a minute swarm of bees. Within this they appear to move quite freely; but the swarm as a whole can be dragged through the water with a needle; and it was demonstrated in other ways that in this species too the swarming individuals are united by mucus. The new sessile groups, formed by the settling of a swarm, sometimes swarmed again after twenty-four hours, and occasionally this was repeated on three or four successive days.

FIG. 1.

We cannot say what is the stimulus that causes *Vorticella* to swarm. Continuous observation, extending over the complete sessile and free-swimming cycle, proved that swarming is not, at any rate immediately, connected with asexual reproduction or with conjugation. Obviously such behaviour, in natural conditions, admirably subserves the dispersal and settlement in contiguity of a gregarious sessile protozoon.

A full account of these observations will be published in the *Proceedings of the Zoological Society*.

H. MUNRO FOX.
H. G. NEWTH.
Department of Zoology,
University of Birmingham.
Aug. 2.

Puff and Profile Theory of the Vowels

THE portions of sound film tracks reproduced in Fig. 1 are from registrations of the vowels *oo* (as in *boo*), *ee* (as in *bee*), *ah* (as in *bah*), *ay* (as in *bay*), *æ* (from *a* in *an*). The registration in each case shows a series of contiguous short bits of vibration in each of which the movement begins strongly and fades rapidly to zero. Such a movement occurs only as a free vibration, that is, as the movement of a vibratory system disturbed in its equilibrium and then left to itself. A vibration of this kind is produced when the air in the vocal cavity is rarefied or condensed by snapping the thumb out of the mouth or by closing and suddenly opening the glottis. Such a sudden

rarefaction or condensation may be termed a *puff*. Repeated puffs will produce a series of free vibrations.

To the eye, each bit of vibration in Fig. 1 has a special *profile*. The profiles of the same vowel are nearly, but not quite, alike ; those of different vowels are different. The eye learns to recognise the profiles automatically just as it recognises the profiles and portraits of persons ; it performs no analysis. No amount of mutilation by lines, blotches or omissions changes the vowel character of a profile. So long as anything can be recognised, it remains the profile of the same vowel ; it never changes to the profile of another vowel.

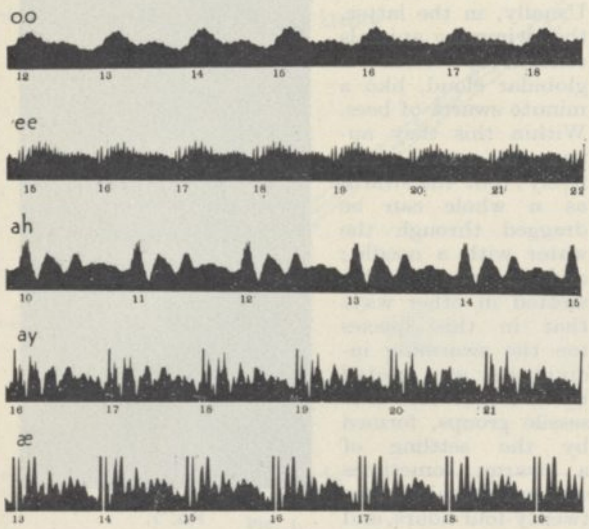

FIG. 1.

The sense of hearing recognises vowel vibrations as the same or different according to their sense impressions, that is, according to the likeness or difference of the profiles. There is no analysis. Experiments in filtering[1] show that any frequency or range of frequency can be removed from the vowel vibrations without changing the vowel character. So long as anything is left, the vowel remains the same one ; it never changes to another vowel. The law of no change of speech character by mutilation is valid here also.

The puff and profile theory agrees with that of Willis-Helmholtz-Hermann in regard to the *production* of vowel vibrations by the action of glottal *puffs* on the air in the vocal cavity. It is opposed to it in asserting that the *perception* of vowel characters depends on the unanalysed *profiles* of the vibrations and not on any special frequencies or groups of frequencies.

E. W. SCRIPTURE.

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[1] See NATURE, **130**, 275 ; 1932.

Magnetism of Copper

A LARGE amount of experimental evidence has been recently put forward to show that colloidalisation of certain metals is accompanied by large changes in their magnetic susceptibilities[1]. I suggested some preliminary ideas to the effect that the increased area of surface of the metal on colloidalisation might be responsible for the observed magnetic changes. Honda and Shimizu[2,3] have recently offered the more definite view that, in the case of tin, the lattice constant is somewhat larger at the surface layer than in the interior, and that consequently the paramagnetic component due to the free electrons decreases and the diamagnetic component due to the bound electrons increases, so that the colloidal powders become more diamagnetic than the massive metal. According to them, colloidalising a metal has the same effect as cold-working, so far as the magnetic properties are concerned.

Copper is a metal for which we have trustworthy magnetic measurements when cold-worked. Honda and Shimizu found that on reducing the density of the metal by cold-working, the diamagnetic susceptibility increased in value, after the necessary corrections were made for the presence of ferromagnetic impurities. A similar increase of the diamagnetic susceptibility was observed when metallic copper was colloidalised.

Colloidal copper was prepared by an electrical dispersion method[4], the dispersing medium being benzene or propyl alcohol. The dispersing and centrifuging experiments were conducted in the absence of air, and hence the possibility of chemical action modifying the results does not arise. It was found that the diamagnetic susceptibility (χ) of copper depended only on the dimensions of the particles and not on the nature of the dispersing medium. The magnetic measurements were made with a Curie balance, with water as the standard substance. Measurements were conducted at different field strengths to correct for the presence of ferrimagnetic impurities.

The specific diamagnetic susceptibility of copper in bulk was found[5] to be 0·080 (all values of χ are given in 10^{-6} units). As the size of the powders decreased from 10 μ to 0·8 μ, the value of χ showed a small increase from 0·080 to 0·090. When, however, the diameter was reduced from 0·8 μ to 0·4 μ, the value of χ showed a relatively larger change, from 0·090 to 0·135. These results fully agree with conclusions of Honda and Shimizu.

It will also be noted that the critical diameter below which χ increases rapidly is 0·8 μ, which is much smaller than the corresponding values for graphite (1·5 μ)[5], bismuth (1·4 μ)[6] and tin (2·0 μ)[1]. Since copper has a face centred cubic lattice, we have no directional variations as in the case of graphite or bismuth. It appears, therefore, most likely that the observed changes of χ in the case of copper colloids are to be attributed to causes quite different in nature from those arising in the crystals just mentioned.

An approximate calculation shows that the surface layer wherein the density is less than the density inside the metal is of the order of a few hundred atomic layers.

Full details will be published shortly elsewhere.

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June 22.

[1] NATURE, **134**, 288 ; 1934 ; *Proc. Ind. Acad. Sci.*, **1**, 123 ; 1934.
[2] NATURE, **135**, 108 ; 1935.
[3] NATURE, **132**, 565 ; 1933.
[4] Svedberg, "The Formation of Colloids", p. 28.
[5] *Ind. J. Phys.*, **6**, 241 ; 1931.
[6] *Ind. J. Phys.*, **7**, 35 ; 1932.

Oxide Film of Alloys containing Small Percentages of Aluminium

WHEN copper alloys containing more than 2 per cent aluminium were heated for many hours at a red heat (800°–900° C), no oxide scales were formed. In cases where several per cent of this element was added, the alloys even retained their characteristic golden yellow lustre, which is a very remarkable fact. Elements such as tin, zinc, nickel, manganese, magnesium, iron, etc., when added to copper do not produce this effect.

The oxidised surfaces were studied by means of cathode ray reflection. Copper surfaces exposed at a red heat gave the CuO pattern. (At lower temperatures, the Cu_2O and a three ring pattern were also observed, as first pointed out by G. P. Thomson and C. A. Murison[1].)

Upon heating alloys containing several per cent of aluminium at a red heat with a Bunsen burner, the surface in contact with air was blackened and gave the CuO pattern, while the surface imbedded in the oxidising flame remained bright and gave a pattern corresponding to that of pure γ-Al_2O_3. No diminution of the lustre of the latter surface was observable after continued heating.

The fact that alloys, containing only about 10 atomic per cent of aluminium, when heated with an insufficient supply of oxygen, become covered with a film of pure Al_2O_3 seems rather striking; because some copper oxide was anticipated. In the case where heating was done in air or in oxygen, the uppermost surface probably becomes covered with an extremely thin film of copper oxide, but beneath this layer, since oxygen is wanting, an Al_2O_3 film might be formed, and this in turn probably protects the inner part from further oxidation. Inasmuch as such a film is colourless, the alloy does not loose its golden lustre, even after prolonged exposure to red heat. The same may be true of iron alloys.

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[1] G. P. Thomson, *Proc. Roy. Soc.*, A, **128**, 649; 1930. C. A. Murison, *Phil. Mag.*, **17**, 96; 1934.

Iridium Isotopes and their Nuclear Spin

AN examination of the hyperfine structure of the arc lines of iridium λλ3800·10, 3513·67 and 2924·81 A. radiated from a modified form of hollow cathode reveals that the three lines having a common lower level in the ground term $5d^86s\ {}^4F_{4\frac{1}{2}}$[1] are identical in structure. The hyperfine components are therefore ascribed to a spin splitting of the ground term with the upper levels unsplit. λ3513·67 A. ($5d^86s\ {}^4F_{4\frac{1}{2}} - 5d^86p\ {}^4G^0_{4\frac{1}{2}}$) exhibits the following structure:

$d\nu$ in cm.$^{-1}$	(Int.)	Remarks
+ 0·072	(7)	This component is diffuse and appears almost as a continuous patch between
0·000	(22)	+ 0·072 and 0·000, indicating the
− 0·073	(13)	presence of an expected satellite at
− 0·145	(9)	+ 0·033 (9). (vide Fig. 1.)

The observed structure is accounted for uniquely by assuming two isotopes of masses 191 and 193 with nuclear spins of $\frac{1}{2}$ and $\frac{3}{2}$ respectively. The ratio of the magnetic moments of the two nuclei is nearly −1·0. The isotope displacement in $5d^86s\ {}^4F_{4\frac{1}{2}}$ is 0·057 cm.$^{-1}$, with the heavier isotope lying deeper, as in the arc lines of copper and thallium.[2] The incompletely resolved patterns of some other Ir I lines λλ3220·79, 2694·22, 2664·77 and 2639·70 A. support the above conclusions. The existence of isotope shift favours the suggestion that the ground term is a $^4F_{4\frac{1}{2}}$ term arising from an electron configuration $5s^25p^65d^86s$ in preference to a $^2D_{3/2}$ term from $5s^25p^65d^9$.[3]

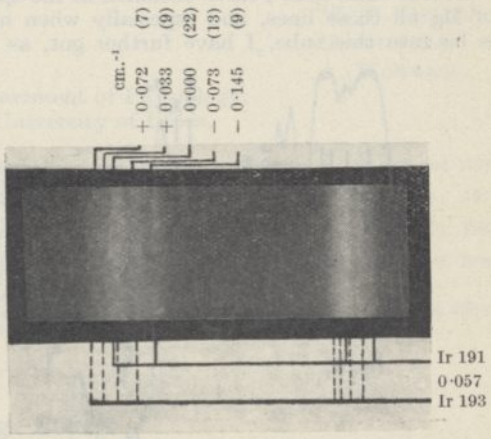

FIG. 1. Structure pattern of Ir I, 3513·67 A. obtained with a Hilger quartz Lummer plate, 3·45 mm. thick, 20 cm. long.

Iridium is one of the few elements the isotopic constitution of which has not so far been revealed by the mass-spectrograph. Judging from a visual estimate of the intensities of the components, the relative abundance of the isotopes 191 and 193 is 1 : 2, giving a value, perhaps a little too low, of 192·4 for the atomic weight of iridium. It appears, however, that the atomic weight of the iridium must be less than 193; there is considerable disagreement in the values of atomic weight given by several investigators, which range from 192·59 to 193·40. The existence of a heavier isotope like 195 is ruled out by the fact that usually there is no isobare in appreciable quantity for an isotope of an element with odd atomic number; and platinum has been previously shown to contain the isotope Pt 195 to the extent of nearly 30 per cent.[4]

Details will appear in the *Proceedings of the Indian Academy of Sciences*.

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[1] Albertson, *Phys. Rev.*, **42**, 443; 1932.
[2] Venkatesachar and Sibaiya, *Proc. Ind. Acad. Sci.*, **1**, 13; 1934.
[3] Meggers and Laporte, *Phys. Rev.*, **23**, 660; 1926.
[4] Venkatesachar and Sibaiya, NATURE, **136**, 65; 1935. *Proc. Ind. Acad. Sci.*, **1**, 955; 1935. *ibid.*, **2**, 101; 1935.

K-Series of Magnesium and Sodium

I HAVE already published[1] some results obtained in the region of long wave-lengths with the ionic tube designed and constructed by me with Prof. Dolejšek[2]. With this ionic tube and with a new focusing method, the principle of which will be described elsewhere, I have obtained some new results which show the great efficacy of our apparatus for long wave-lengths of X-spectra.

As an example of what can be obtained by our

ionic tube, I should like to point out in this connexion that with the ionic tube alone, using the normal Bragg method, I obtained the new non-diagram lines in the K-series of Mg and Al which were recently found by Prof. M. Siegbahn and H. Karlsson[3] using new focusing methods, which they have worked out. By our new focusing method and with this ionic tube I have obtained in the spectrum of Mg all these lines, and especially when nitrogen is let into this tube, I have further got, as can be

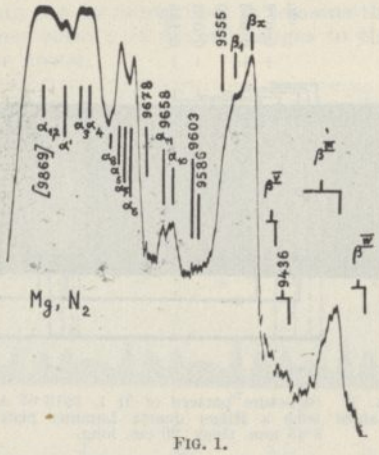

FIG. 1.

seen from the microphotometric curve (Fig. 1), the lines in the α-group as well as those in the β-group, which have not hitherto been observed.

In the emission spectrum of MgO, when oxygen is let into our ionic tube, there are certain changes; for example, in the α-group the lines 9603 and 9586 X. do not occur and $\alpha_{10,11}$ appear as a single broad band, and changes analogous to these also occur in the lines of β-group. I have found similar characteristic qualities in the spectrum of sodium

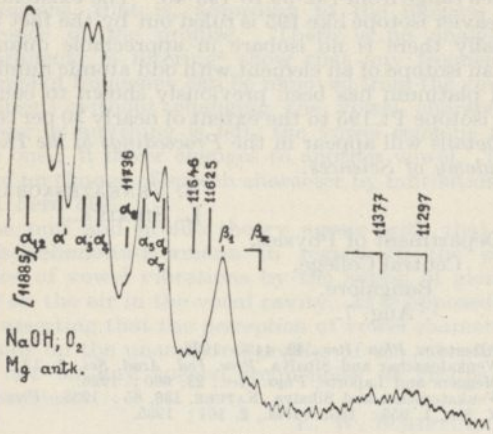

FIG. 2.

oxide. The microphotometrical curve of the spectrum of sodium (NaOH on the magnesium anticathode) is reproduced in Fig. 2. In these curves the lines which were hitherto neither known nor measured are indicated with their wave-lengths.

Both spectra were obtained using an effective tension of 2,000 v. and 200 ma. in the case of Mg, and 1,500 v. and 200 ma. in the case of Na, thus avoiding the occurrence of lines of higher orders.

As in the above investigation on the emission spectra of the K-series, I have tried to find the white absorption lines, which I have obtained while studying the M-series with the ionic tube and without the use of the focusing method. In the place where I formerly found two white lines and classified them as M_{II} absorption of Ta, I have now got these white lines and also obtained a complicated structure. But this absorption effect, classified by me as M_{II} absorption of Ta[4], must be classified as the absorption structure of sulphur from the crystal, which has not been observed until now. In the place where I formerly obtained the white line and classified it as M_I absorption of W, I have now again got the same line, and at present from our results it is not possible to find any other classification for it. It is necessary, however, to reinvestigate this identification since the results for both elements do not agree. This will be possible after obtaining more experimental data.

The examples mentioned of the results in the K-series and the absorption of sulphur show that our ionic tube, in connexion with any focusing method, gives further possibilities in the region of long wave-lengths.

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July 15.

[1] V. Kunzl, NATURE, **132**, 139; 1933. *Acta Phys. Polonica*, **2**, 447; 1934.
[2] V. Dolejšek and V. Kunzl, *Z. Phys.*, **74**, 565; 1932.
[3] M. Siegbahn and H. Karlsson, NATURE, **132**, 895; 1933. *Z. Phys.*, **83**, 76; 1934.
[4] V. Kunzl, l.c.

Action of Benzylcarbonyl Chloride on Insulin and Other Proteins

IN previous investigations, the reaction between phenyl *iso*cyanate and proteins has been used to study the immunological properties of protein antigens[1]. In other investigations[2], it was found that insulin is readily inactivated by phenyl- and *p*-bromo-phenyl *iso*cyanates, and from the information derived from the earlier work, the conclusion was reached that this inactivation is due to a reaction between the *iso*cyanate and the free amino-groups of the insulin. Jensen and Evans simultaneously investigated this inactivation of insulin[3], and reached somewhat similar conclusions.

Recently, we have been studying the action on proteins of benzylcarbonyl chloride ($C_6H_5.CH_2.O.CO.Cl$), the reagent used with such success by Bergmann and his co-workers[4]. These chemical and immunological investigations are not yet complete, but sufficient evidence is available to show that this reagent reacts quite readily with native proteins, just as it does with the free amino-groups of amino-acids and simple peptides. This reaction, like that between phenyl *iso*cyanate and proteins, is quite mild, and proceeds smoothly at about *p*H 8 and 5° C. As the reaction continues, there is a marked diminution in the free amino-nitrogen of the protein, and in many cases, the product (benzylcarbonato-protein) contains practically no free amino-nitrogen. On injection into rabbits, the benzylcarbonato derivative of serum globulin produces antibodies which, from precipitin and inhibition tests, appear to be specific for the new grouping in the protein (the benzylcarbonato-amino acid group).

In the course of chemical and immunological investigations on insulin, the physiological activity of benzylcarbonato-insulin has been studied, and it has been found that this derivative has no significant

hypoglycæmic power. Benzylcarbonyl chloride readily inactivates insulin, probably just as rapidly as does phenyl *iso*cyanate, and in this inactivation also it seems probable that the loss of hypoglycæmic power by the insulin is due to the blocking of the free amino-groups. This appears to offer additional support for the view that the active groups of insulin contain free amino-groups, and that the latter are essential for the activity of the insulin (cf. Jensen[5]). Attempts are now being made to activate these inactive insulin derivatives.

The amount of benzylcarbonyl chloride required to inactivate insulin is very small, and 100 mgm. of insulin of potency 19,500 units per gm. (kindly supplied by Messrs. Boots Pure Drug Co., Ltd.), can be completely inactivated by 150 mgm. of this reagent. The minimum amount of benzylcarbonyl chloride needed to react with all the free amino-groups of insulin, calculated on the basis that insulin contains 1·0 per cent of free amino-nitrogen[6], is approximately 12 mgm. per 100 mgm. of insulin. This smaller amount of acid chloride causes partial loss of hypoglycæmic activity only, possibly because some of the reagent may be destroyed by the water present. It is possible, however, that the reaction with benzylcarbonyl chloride is not confined to the free amino-groups of the insulin, and further investigations are being made to decide this point.

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[1] Hopkins, S. J., and Wormall, A., *Biochem. J.*, **27**, 740 and 1706; 1933. **28**, 228; 1934.
[2] Hopkins, S. J., and Wormall, A., NATURE, **134**, 290; 1934. *Biochem. J.*, **28**, 2125; 1934.
[3] Jensen, H., and Evans, E. A., *J. Biol. Chem.*, **108**, 1; 1935. *cf.* also, *Physiol. Rev.*, **14**, 188; 1934.
[4] Bergmann, M., and Zervas, L., *Ber.*, **65**, 1192; 1932. *cf.* Bergmann, NATURE, **131**, 662 and 698; 1933.
[5] Jensen, H., *Science*, **75**, 614; 1932.
[6] Freudenberg, K., Dirscherl, W., and Eyer, H., *Z. physiol. Chem.*, **202**, 128; 1931.

Points from Foregoing Letters

SIR JAMES JEANS compares the observed eccentricity of the orbital motions of binary stars with that calculated from the principle of equipartition of energy. He points out that there is a good agreement between the calculated and observed figures, which supports the long time scale (10^{13} years) for the life of the universe.

To explain certain observations on blood group inheritance, Ffoulkes Edwards and Etherington have suggested the existence of a fourth hereditary unit (allelomorphic gene). Prof. J. B. S. Haldane points out, as one alternative explanation, that in some individuals the three known allelomorphs may be carried by three chromosomes, instead of by two, and he suggests ways of testing this hypothesis of 'trisomy'.

Prof. V. F. Lenzen offers a few remarks on the philosophical basis of science upon which, he hopes, all philosophers of science can agree.

Mr. A. E. Needham shows that Weldon's case of change of proportions in the growth of young shore crabs is due to heterogonic growth in the individual, and is not a mere average effect produced by natural selection.

The incidence of rickets in a new strain of 'rex-coated' rabbits (with mole-like fur) is described by W. King Wilson. Attempts to prove the recessive nature of the disease by mating individuals suffering from rickets were unsuccessful.

Vitamin C (ascorbic acid), in concentrations of 1 to 5 parts in 10,000, is found by László Havas to accelerate the growth and increase the length of the shoots of germinating wheat.

Prof. H. Munro Fox and Mr. H. G. Newth describe the swarming behaviour of two common species of gregarious vorticellids. All the individuals in a group become free-swimming simultaneously and form a swarm which is held together by mucous threads secreted by the swarmers. When the latter again settle down, they do so in close contiguity owing to their mucous attachments.

Prof. E. W. Scripture submits reproductions of sound-film tracks for various vowels. He points out that they support the 'puff and profile' theory, according to which vowel vibrations are produced by the action of glottal puffs on the air in the vocal cavity, and the perception of vowel characters depends on the unanalysed profiles of the vibrations.

Prof. S. Ramachandra Rao finds that the diamagnetic susceptibility of colloidal copper is greater than the value for the massive metal. The critical diameter of particles below which the susceptibility shows a rapid increase is 0·8 μ. The results support the conclusions of Honda and Shimizu that colloidalisation has the same effect as cold-working so far as the magnetic properties are concerned.

The protective effect of aluminium upon the oxidation of copper at red heat is described by I. Iitaka and S. Miyake, who have studied the oxidised surfaces by means of cathode ray reflection. Copper alloys containing more than 2 per cent of aluminium can be heated to a red heat for several hours without forming oxide scales. An alloy containing about 10 per cent, when heated with an insufficient supply of oxygen, becomes covered with a thin film of oxide.

From the hyperfine structure of certain lines of the arc spectrum of iridium—the only element the isotopes of which have not hitherto been identified—Prof. B. Venkatesachar and L. Sibaiya infer the existence of two isotopes of masses 191 and 193 with nuclear spins of $\frac{1}{2}$ and 3/2 respectively. A rough estimate of the relative abundance of the two isotopes is 1 : 2, which in the absence of a higher isotope would lead to an atomic weight of less than 193 for iridium.

By means of the ionic tube designed by Kunzl and Dolejšek, for the detection of the longer X-ray waves and with a new focusing method, Dr. V. Kunzl has observed several new lines in the X-ray spectra of magnesium and sodium. He now ascribes to sulphur certain 'white lines' previously classified as due to the absorption spectrum of tantalum.

The observation that Bergmann's reagent (benzylcarbonyl chloride) inactivates insulin is considered by W. E. Gaunt, G. Higgins and Dr. A. Wormall as additional support for the view that the free amino-groups of insulin are essential to that compound's power of reducing the sugar content of the blood.

Research Items

Glazed Stones

In continued study of glazed stones, Mr. H. L. Beck deals with glazed quartz and carnelian, agate and felspar (*Ancient Egypt and the East*, Pt. 1, 1935). In the glazing of quartz (including quartzite and chert), great care has to be taken to prevent flawing of the quartz base. The glazing of quartz was practised in Egypt from Predynastic times to the eighteenth dynasty. In Mesopotamia, beads are found at different dates in two varieties, *high polish* and *frosted*, so called on account of the present surface. Some at Ur are dated from before 3500 B.C., though some of A.D. 900 are identical. Beads are also found in Persia and Syria. Three of the high polish variety were found at Mohenjo-daro, one, a lenticular cylinder, being of a shape not recorded in either Mesopotamia or Egypt. A number of specimens of glazed quartz have been found in northern India, which are dated at the first century A.D. No specimens are reported from Europe; and the process is not practised to-day. The great majority of specimens of glazed quartz from Egypt are beads. In India there is a number of small but elaborately worked pendants representing animals. In Egypt a soda glaze coloured was applied to the bead and then fused. The Mesopotamian coloured beads were hammered to cover them with conchoidal fractures before glazing. In the high polish beads the surface is altered by an alkali. It is possible that all types were coloured. The most important other stones chemically treated were carnelian, agates and chalcedonies. They were not actually glazed, but received a special treatment in which soda was added, usually as a decoration. Many carnelian beads have a white patination; but it is difficult to say whether it has been purposely applied or is due to action of the soil.

Kmer Art and the Cultures of Precolumbian America

M. Henri Marchal offers (*J. Soc. Américanistes*, N.S., **26**, 2) a tentative explanation of certain remarkable features in Kmer art, which appear out of harmony with its Indian origin and its relation through the art of India with that of ancient Egypt, Greece and the Mediterranean. These incongruous elements are to be attributed to the Polynesian influences which have been discerned in the art of Java and Bali, and also in America. As an example may be taken the monstrous heads, known in Cambodia as *Rahu*, which with the *naga* form one of the dominant motifs in Kmer art. The characteristic lineaments appear nowhere in occidental art (except in the head of Medusa and its derivatives) but are to be found in the Mayan art of America, especially in the heads placed over the openings into buildings, for example, at Palenque, exactly as they are used in Cambodia and Java. They are to be found also on Toltec pottery, where the god Tlaloc is represented without lower jaw. This motif is scattered widely over Polynesia, appearing in Maori art, especially in the carved wooden lintels and gables of New Zealand, and the tattoo-markings and petroglyphs of the Marquesas. The head with flanking forearms or claws of America does not appear in Polynesia, but is present in China. Superimposed heads forming balusters before the entrance to Kmer temples may be compared with sculptured figures of Piedras Negras in Central America. A striking resemblance which has impressed everyone who has visited both localities is to be found in the general profile of the *teocallis* or pyramidal mounds of America and the *prasat* of Cambodia. Step pyramids surmounted by sanctuaries in Mayan architecture find their analogies in Kmer temples such as Phimānakas, Bakon and above all the Pran of Kohker. Among other resemblances in construction are the introduction of a wooden beam in masonry work, the projecting stone which is carved, the use of the serpent for decorative purposes, and the employment of the corbelled arch.

Fishes from the Philippine Islands

The *Philippine Journal of Science*, **55**, No. 3, 1934, contains three papers on fishes: (1) "The Philippine Phallostethidae, a Description of a New Species, and a Report on the Biology of *Gulaphallus mirabilis*, Herre" by D. V. Villadolid and P. R. Manacop; (2) "Philippine Sillaginidae" by M. C. and H. R. Montalban; and (3) a long systematic paper on Philippine Isospondylous fishes by A. H. Roxas. The Philippine Phallostethidae comprise a very interesting group of fishes, unique in having a peculiar sexual organ in the male, named the priapium by Tate Regan, who first discovered it in 1913. The pelvic fins are vestigial in the female and absent in the male, the latter having below the head and throat this priapium containing the coiled vas deferens and the end of the intestine, together with a complicated skeletal system consisting of two long curved bones, proved in the present paper to be used as a clasping organ. The eggs are probably fertilised as they pass through the oviduct, and when laid are provided with adhesive thread-like processes with which they attach themselves to weeds. These filaments seem to suggest that the genus is more closely related to Percesoces than to the Cyprinodontes where they are usually placed. Spawning appears to continue throughout the year. Interesting notes on food and feeding habits are added, *Gulaphallus* having a mixed diet both in young and adult consisting of vegetable matter which is less as the animal grows, insects, especially chironomid larvæ and pupæ, which rank first in importance, small crustacea and even the larvæ of its own species, eaten by both young and old but only in January when the breeding season is at its height. The development of *Gulaphallus mirabilis* is described from the newly hatched egg to the time when the priapium is fully formed—in about 19–20 weeks after hatching.

Germ-Cell Cycle in the Hessian Fly

Margot E. Metcalfe (*Quart. J. Micr. Sci.*, **77**, Pt. IV; 1935) has investigated the germ-cell cycle in the Hessian fly, *Phytophaga destructor*. The somatic cells in both sexes contain four pairs of V-shaped chromosomes. The germ-cells in both sexes contain eight pairs of chromosomes. In the maturation of the egg, eight bivalents are formed, which divide but remain in anaphase until the time of fertilisation.

The polar bodies are then formed, but are never extruded from the egg; they migrate to the surface of the egg, divide irregularly and eventually degenerate. The female pronucleus has eight chromosomes. In spermatogenesis, reduction is effected in a peculiar manner. In the first spermatocyte the chromosomes separate into two groups, of twelve and four respectively, and the four pass into a process of the cell which separates as a small cell. After a short period of rest, the spermatocyte again divides unequally, the resulting spermatid having eight chromosomes and the second bud four chromosomes. Thus each spermatocyte gives rise to one sperm only. The germ-line (that is, the germ-cell nucleus). is differentiated after the third cleavage, that is, in the eight-cell stage. At the fourth cleavage the germ-cell nucleus divides synchronously with the somatic nuclei; there are sixteen nuclei each with sixteen chromosomes. At the fifth cleavage the somatic nuclei eliminate eight chromosomes and are left with eight chromosomes.

Hystricoid Rodents of the Neotropical Region

A VALUABLE, if necessarily dull, account of the taxonomy of these rodents has appeared (*Bull. Amer. Mus. Nat. Hist.*, **68**, Art. 5; 1935). The author, G. H. H. Tate, gives fully for each genus its pre-Linnean and post-Linnean taxonomic history, discusses special points of difficulty, indicates the genotypes, and gives a list of all the named forms, specific and sub-specific, with their type localities.

New Garden Alpine Plants

NUMEROUS expeditions to Persia, Tibet, Burma, the Andes and other places have recently been organised for the purpose of collecting new plants for the enhancement of garden beauty. The names of Farrer, Kingdon Ward, Giuseppi, Comber, Ball and others are well known among gardeners for their activities in botanical exploration, and modern gardens owe much of their interest to them. An article by Dr. H. R. Smith on "New Alpines" (*J. Roy. Hort. Soc.*, **60**, Part 6, pp. 246–255, June, 1935) enumerates an imposing list of plants for the rock garden which have been introduced during the last five years as a result of such botanical exploration. Lilies and rhododendrons are not treated, but more than sixty species belonging to other genera are described. Campanulas, primulas, gentians and narcissi are well represented, and brief accounts of the circumstances of their introduction are given.

Life-Histories of British Pyrenomycetes

MR. C. G. C. CHESTERS has commenced a series of studies on British Pyrenomycetes. The whole life-histories of most members of this division of the fungi are not known, and many phases probably lie buried among the taxonomic labyrinths of the Fungi Imperfecti. Pure culture methods are used in the investigation, and the first part of the work is devoted to "The Life-Histories of Three Species of Cephalotheca" (*Trans. Brit. Mycol. Soc.*, **19**, Part 4, June 1935). The three species which have been recognised are *C. sulfurea*, *C. purpurea* and *C. reniformis*. These are described in minute detail, and characters of the genus are also given. Extensive lists of synonyms appear, and the mass of detail portrayed in the paper is crystallised into a very simple determinative key at the end.

The Formosa and Quetta Earthquakes

A PRELIMINARY report on the Formosa earthquake of April 21, by Mr. R. Takahasi, is published in the *Proceedings of the Tokyo Imperial Academy* (**11**, 224–226; 1935). The number of lives lost was 3,276, and that of the houses completely destroyed 121,398, this great number being due to the poor construction of the houses. Displacements occurred along several faults during the earthquake. Along one, more than six miles in length, the horizontal and vertical displacements were respectively 6 in. and 2 in. Along another, a thrust fault of about the same length, the horizontal movement was slight, but the vertical shift amounted to 10–12 in. The epicentre lay in about lat. 24° 22′ N., long. 120° 48′ E., or between the two above faults. The detailed report will appear later in a special volume of the *Bulletin of the Earthquake Research Institute*. In a paper in *Science and Culture* (**1**, 71–72; 1935), Messrs. S. N. Sen and R. Bakshi determine the epicentre of the Quetta earthquake of May 31 as in about lat. 30½° N., long. 66½° E., or along the Khojak Range just to the south of Chaman and about sixty miles north-west of Quetta. Thus, the origin of the recent earthquake coincides closely with that of the severe earthquake of December 20, 1892, caused by a large displacement along the boundary fault which has been traced for a distance of 120 miles.

Thermodynamical Relations

PART NO. 740 of vol. 234 of the *Philosophical Transactions of the Royal Society*, A, is devoted to a communication by Prof. A. Norman Shaw of McGill University on "The Derivation of Thermodynamical Relations for a Simple System". The aim of the author is to outline a systematic procedure for effecting transformations of thermodynamical formulæ which involve quantities not directly determined by experiment or determined with low accuracy, in order to replace them by quantities directly observed or determined with higher accuracy. The method adopted is that of converting any thermodynamical equation involving the usual quantities p, v, T, S, E, I, F and G and their derivatives with respect to each other into an equation connecting Jacobians of the partial derivatives of two quantities x and y with respect to two independent variables α, β by assigning to x, y, α, β values identical with any number up to four of the above thermodynamical quantities. Thus the thermodynamical equation $dE = TdS - pdv$ is converted into $J(xE) = TJ(xS) - pJ(xv)$ where J is the symbol for Jacobian and x and the independent variables α and β are undetermined. Once the equations are in Jacobian form the laws of transformation of Jacobians can be utilised to effect the thermodynamical transformations required. To facilitate the work four tables are given in which x, y, α, β are assigned values p, v, T, etc., and the resulting Jacobian expression tabulated in terms of five of the simplest Jacobians. Instructions for the use of the tables and worked examples are given as well as 35 equations useful in manipulations of J functions.

The Electronic Oscillator

CONSIDERABLE research has been carried out recently on the generation of electrical oscillations corresponding to wave-lengths of 10–100 cm., by means of the valve circuit arrangements first demonstrated by Barkhausen and Kurz. The

theoretical study of this subject has resulted in the publication of much complicated analytical work, the physical principles of which have at times been somewhat difficult to visualise. The author of some of this theoretical treatment, Mr. F. B. Llewellyn, has presented a simple statement of these principles in plain language in an article entitled "The Barkhausen Oscillator" published in the August issue of the *Bell Laboratories Record*. The case considered is that of a simple triode valve operating with a positive grid potential; and the oscillating motion of individual electrons between cathode and anode through the spaces of the grid is dealt with. The difference in motion of these electrons due to the static forces alone and with the superimposition of the alternating forces due to the potential difference across the external tuned circuit is explained and illustrated graphically. The maintenance of oscillations is shown to be due to the non-symmetrical motion about the grid of those electrons which are correctly phased relatively to the alternating forces, and the consequent transfer of some of their energy into the external tuned circuit. The tuning of this circuit can modify the frequency of the oscillations by about thirty per cent, but for fixed supply voltages of the valve electrodes, there is a particular tuning adjustment which gives maximum output.

Platinum Electrode in Solutions of Foreign Ions

MR. I. ORESTOV, of the Middle Asiatic State University, Tashkent, informs us that he has studied the behaviour of a platinum wire electrode in a series of solutions of potassium sulphate of normalities 0·5005, 0·1001, 0·0500 and 0·0100, with a salt bridge and saturated calomel electrode:

$$Pt|K_2SO_4(c)|KNO_3(sat.)|KCl(sat.)|Hg_2Cl_2|Hg$$

and very variable potentials were found. When, however, a stream of pure nitrogen was passed through the left-hand half element, a reading taken after 90 minutes showed that all four electrodes had on the average the same potential of 0·2336 ± 0·0010 volt. Observations with one electrode (N K_2SO_4) at 23·1° were then made every minute and 90 readings obtained. These were arranged in a statistical row which was found to correspond very closely with the natural theoretical row, the standard deviation σ being ± 2·35 mv., the index of closeness of fit (Pearson) being $\Delta = \pm 2{\cdot}33$, the asymmetry number S being + 0·23, and the excess $Ex = + 0{\cdot}2$. The source of the fluctuations, following a suggestion of Posner, is regarded as the fluctuations of ions in a Helmholtz double layer on the electrode. Further observations are in progress, when the theory of fluctuations (Smoluchovsky-Svedberg) will be applied to the results.

Probability and Frequency

A SATISFACTORY basis for the theory of probability has not yet been found. The weakness of the 'equally-likely' definition is well known, but the 'statistical' or 'relative frequency' definition, favoured by Chrystal and others, is also open to objection. An interesting discussion of some of the fundamental difficulties has been given recently by F. P. Cantelli (*Ann. l'Institut Henri Poincaré*, **5**, 3; 1935). If a symmetrical coin, equally likely to turn up head or tail, is tossed a large number of times, it is not certain that the proportion of heads will be exactly ½. What is more, it is not even certain that the proportion will approach ½ as a limit; for if it were, to any number ε, however small, there would correspond a number N such that for every set of N or more tosses the proportion of heads would *never* differ from ½ by more than ε. But this is not true; long runs of heads or of tails are not impossible, a fact which is awkward for mathematicians as well as for gamblers. The statement of the approach to the limit must be weakened, with *never* replaced by *scarcely ever*. The principal object of Cantelli's work is to express this replacement in precise mathematical terms drawn from the theory of aggregates.

Molecular Weights by the Ultra-Centrifuge

THE most satisfactory method for the determination of the molecular weights of macromolecules is by means of sedimentation equilibrium in the Svedberg ultra-centrifuge. The equations can be developed by thermodynamics, so that for sufficiently dilute solutions the shape of the molecule is not involved. In the case of material containing molecules of different sizes, average molecular weights are obtained. It is then necessary, for purposes of comparison with values found by other methods, such as viscosity determinations, as used by Staudinger, to have properly defined averages, and W. D. Lansing and E. O. Kraemer (*J. Amer. Chem. Soc.*, **57**, 1369; 1935) have distinguished three such averages. The first, the number average, M_n, corresponds with osmotic methods involving counting of the molecules; the second, the weight average, M_w, corresponds with Staudinger's method, and a third, the so-called 'Z-average' molecular weight, M_z, is obtained from centrifuge data. The concentration of a solution subjected to a centrifugal or gravitational field is such that the concentration gradient at equilibrium ensures that at every point the chemical potential is equal but opposite in sign to the gravitational potential. Equations can then be set up giving the molecular weight from the experimentally observed concentration gradient. If this value varies with the distance along the cell, the material is assumed to be non-homogeneous. The authors enter into a detailed discussion of the calculation of the average molecular weights and apply the results to experiments on gelatin. The equations enable a correct comparison to be made between results obtained by different methods, thus avoiding a good deal of confusion which has hitherto resulted in this field.

Distance of Nova Herculis

THE majority of novæ are so far away that accurate measurements of their distances are very difficult to obtain. Trigonometrical parallaxes are too small to be trustworthy, and the best method so far depends on the rate of expansion (when available) of the surrounding nebular disc. An entirely independent method is now possible through the relation between distance and interstellar calcium absorption. This has been used in the case of Nova Herculis by E. G. Williams (*Monthly Notices, R.A.S.*, **95**, 573), who has measured the intensity of the interstellar [K] line on twenty-four plates taken at Cambridge. The large displacements of lines due to the Nova itself, together with the absence of lines which might blend with the interstellar line, make these measurements comparatively simple. They yield a distance of 370 parsecs for Nova Herculis, corresponding to an absolute magnitude at maximum of − 6·5 and a pre-outburst magnitude of about + 6·7.

International Society of Leather Trades' Chemists

THE bi-annual Conference of the International Society of Leather Trades' Chemists was held at the Institut des Arts et Métiers, Brussels, on September 1–6, jointly with the bi-annual meeting of the German sister society, the Internationalen Vereins der Leder Industrie Chemiker. Owing to the national mourning for Queen Astrid, some of the social functions in connexion with the Conference were cancelled. The meeting, however, was pronounced as one of the most successful yet held.

The Conference proper opened on Monday, September 2, under the chairmanship of M. G. Colchen (president of the Belgian Section, I.S.L.T.C.), assisted by Mr. Van Gijn (president of the I.V.L.I.C.) and M. C. R. Loos (president of the I.S.L.T.C.).

The Executive of the I.S.L.T.C. for 1936–37 was elected as follows: *President*, M. G. Colchen (Belgium); *Vice-Presidents*, M. C. R. Loos (France) and W. R. Atkin (University, Leeds); *Treasurer*, Prof. D. McCandlish (University, Leeds); *Hon. Gen. Secretary*, Dr. J. Gordon Parker (London); *Members of Committee*, Dr. P. Chambard (France), Dr. A. Gansser (Italy), M. R. Paniker (Spain) and L. Masner (Czechoslovakia). It was decided to hold the 1937 conference at Copenhagen. Dr. J. Gordon Parker was elected an honorary member of the Society in appreciation of the enormous amount of work he has devoted to its welfare. The official methods of analysis of the Society are to be published in book form, and it is hoped to have the publication ready by the end of the year.

Kubelka, Weinberger and Heger showed that acid rotting of vegetable tanned leather can be detected by extracting the sample first with water and then with 1 per cent caustic soda solution, and determining the nitrogen in the extracts, rotting being indicated by unusually high amounts of soluble nitrogen. Kubelka and Nemec demonstrated that the deposition of tannin sludge from a liquor depends upon concentration, the sludge increasing with concentration up to a maximum, and then on further concentration decreasing in quantity. In discussing the effect of metallic iron on vegetable tanned leather, Kubelka, Nemec and Zuravlev stated that the presence of unsaturated and oxy fatty acids in oils used for dressing resulted in a greater uptake of iron than with saturated acids such as stearic acid or neutral greases such as paraffin wax.

Dr. D. Jordan Lloyd discussed the modern theories of tanning, stating that X-ray examinations of collagen and of good quality and poor quality sole leathers show that tanning occurs at the active centres of the side chains of the collagen molecules and influences the side chain spaces of the bundles of parallel molecules that go to build up the collagen fibril (or fibre). If the tanning processes weaken or affect the collateral forces directly binding the backbones of the bundles of collagen molecules, or the longitudinal forces down the backbones of the molecules, the leather is of poor quality. All these inter- and intra-molecular forces can of course be affected by the pre-tanning processes, such as those which have been used for curing and in beamhouse work.

The influence of the hydrogen ion concentration of suspender tanning liquors on the fixation of tannin was the subject of a paper by G. Rezabek. He showed that at *p*H 4, hide powder fixes about one sixth to one quarter more tannin than at the natural *p*H of the liquors, namely 5 or 6. Tannage in alkaline medium, that is, at *p*H 8, gives approximately the same tannin fixation as in the non-adjusted liquors. The value of the microscope was illustrated by Dr. R. H. Marriott, who emphasised the value of an understanding of the fibre structure of leathers when assessing their value. Apart from its use in examining finished leather, microscopical examination is of the utmost value in detecting faults in the early manufacturing processes.

Dr. A. Jamet described a method for the estimation of formic acid in lactic acid based on distillation in the presence of a definite amount of lactic acid, whereby the formic acid can be recovered almost quantitatively. Dr. V. Casaburi and Dr. E. Simoncini discussed tanning by means of tungsten salts, particularly those of a more complex type. These tungsten compounds also act as excellent mordants for dyeing. A study on the action of nitrous acid on collagen, and the properties of the de-aminated collagen, was presented by Prof. L. Meunier and Dr. E. Schweikert. An excess of nitrous acid results in a true tanning effect, particularly if followed by treatment with sodium bisulphite. Further, at the iso-electric point of collagen, sodium nitrite alone has a marked tanning effect on collagen. The action of acids and basic dyestuffs towards deaminated collagen were described in some detail. Prof. C. Otin and G. Alexa gave an account of their work on the fixation of vegetable tannins by pre-chromed hide powder, indicating that the amount of vegetable tannin fixed depends upon the quantity of chromium present, also on the particular vegetable tannin used.

Some work on the accuracy of the glass electrode in alkaline solutions was discussed by Dr. D. Burton and J. Bateson. Prof. L. Meunier with A. Abbassi showed that a sulphur tannage takes place when pelt is treated with an acid pickle (salt and sulphuric acid) followed by a sodium thiosulphate bath. A very practical paper was that by L. Houben, who demonstrated the important part played by the stuffing grease mixture on the efficiency of leather belting. Prof. L. Meunier with P. Audrey described a method for preparing a uniform ossein from bones, and showed that this can be used as a substitute for hide powder in the determination of tannin in vegetable tanning materials. The estimation of methoxy (in the form methyl alcohol) in vegetable tannin extracts is the basis of a method for determining the presence of sulphite cellulose described by C. van der Hoeven.

In a paper on the theory of leather dyeing, Dr. G. Otto suggested that in dyeing with anionic reacting dyestuffs, the reaction of the principal valencies is more or less influenced by auxiliary valencies. Dr. F. Stather described experiments he has made on the relative rates of diffusion of vegetable tannins into pelt. Dr. Pollak gave details of his method for determining pyrogallol tannins in the presence of catechol tannin, the latter being precipitated by formaldehyde and hydrochloric acid (Stiasny), and then the former by urea. Sulphite cellulose extract

formed the subject of a paper by Dr. Kuntzel, who showed that this material is taken up by the basic groups of the hide substance molecule, and acts generally like the synthetic tannins.

A conclusion arrived at in a paper by Dr. E. Elod on the dyeing of leather is that if a series of acid or direct dyes be arranged in order of their dissociation constants, such order represents also their relative fastness to washing. The importance of drying in leather manufacture was discussed by Dr. K. Wolf, who mentioned that drying occurs in two stages, first the evaporation of the loosely held water, and secondly the loss of bound water, this latter being governed by the type of tannage and degree of tannage of the leather. Dr. W. Grassmann dealt with the chromatographic adsorption analysis of tanning materials. This depends on passing the solution through a tube of an adsorbent material (silica gel, kaolin, etc.) when a characteristic separation occurs, the strongly adsorbed constituents being retained in the upper layers while other constituents infiltrate to various depths. The preparation of sulphite cellulose extracts was discussed by L. Masner and V. Samec, and Dr. W. Hausam described certain pin hole defects in calf and goatskin.

Prof. Leplat gave an interesting lecture on the need for closer co-operation between the histologist and leather technologist, and showed how the newer science of histo-chemistry has been able to differentiate structural differences between tendon fibre and skin substance, which may account for their different behaviour on acid swelling.

Higher Agricultural Education in Great Britain

THE Report of the Departmental Committee on the Reassessment of Annual Grants to Institutions providing Higher Agricultural (excluding Veterinary) Education in England and Wales, 1934, is regarded by the Minister of Agriculture as of such importance that the non-confidential portions have been reproduced in full in the *Journal of the Ministry of Agriculture* of August 1935. It is understood, however, that some of the recommendations have already been implemented.

The fifteen institutions concerned, comprising agricultural colleges and university departments of agriculture, were visited by members of the Committee, and all available information as to work and finances considered in detail. The Committee lays great stress on the importance of education and research for the development of agriculture, quoting many specific instances where the results of research have materially altered the methods of agricultural practice. The importance of the agricultural colleges lies in the fact that experience shows that the farmers who are the first to introduce improved methods on their own farms and, indirectly, to their neighbours, are those who have received training at a college or farm institute. Any attempt to reorganise the agricultural industry in Great Britain must, therefore, ensure that the agricultural colleges are on such a footing that they can perform their functions with efficiency.

The attitude of the Committee was sympathetic and liberal, the object being to make such recommendations as would ensure the financial stability of each institution, without countenancing any waste or unnecessary expenditure of public money. At the same time, it was agreed that it is a mistake to penalise an institution that is successful, and that one that is so well managed that it pays its way should not on that account alone suffer a reduction in its grant. The financial crisis of 1931 prevented any increases in grants, and caused reductions in many cases, and as lowered incomes from this and other sources mean reduced expenditure, the position of the colleges in 1934 was one of stagnation due to lack of funds, rendering them unable to play their full part in the leadership of the agricultural industry.

Most of the colleges work in direct relation to the surrounding county areas ; but the amount of local financial support varies considerably, both as regards direct grants and the award of scholarships, and in some cases this support is far from adequate. An increase in both types of financial aid from certain counties is very desirable, together with a greater co-operation for making the facilities provided by the colleges more widely known.

In most cases the existing staff is adequate to meet present demands, but the level of the salaries paid leaves much to be desired. This, added to the salary cut imposed in 1931, has resulted in deplorable conditions in certain specified colleges, and recommendations have been made for extra grants to improve conditions.

One result of the 1931 depression has been a fall in the number of fee-paying students, with a certain increase in scholarship holders, and in some cases the quality of the students is less good than formerly. It is recommended that the colleges should be pressed to satisfy themselves that all their students are suitably equipped to benefit by their course of instruction, and that a more rigorous attitude should be adopted in the weeding-out of students who are not availing themselves of their opportunities. At the same time, it is desirable that every effort should be made to increase the numbers of students drawn directly from agricultural circles, which can be encouraged by scholarships given by the Ministry and by county authorities. There seems to be scope for a much greater measure of county assistance in this respect.

The attention of the Committee was also directed to the question of adequate farm areas attached to the colleges. Although most colleges already possess such farms, in some cases they might be used more freely for the practical instruction of the students. For urban colleges, the distance to the farm may present difficulty, and in one instance the establishment of a local farm institute on the farm itself has been recommended as the condition of the continuance of the existing grant.

In spite of the reduced incomes, due to various causes, it is most undesirable that any increase in the level of fees paid by students should be made, as even now the cost is too heavy for members of the agricultural classes without the aid of scholarships or reduced fees. The heavy burdens of interest charges and bank overdrafts could best be dealt with

by increases of grant sufficient for their gradual reduction. Considerable items of capital expenditure still call for the Ministry's contribution on a pound for pound basis; but if possible, smaller items should be met out of a margin provided by an adequate annual grant.

As a measure of security for the proper use of the suggested increased grants, the report proposes that annual visits should be paid to colleges and farms by responsible officials and technical officers of the Ministry. It also recommends that members of the county committees should periodically visit any college to which a grant is made, with the view of increasing the co-operation between colleges and counties.

If the suggestions outlined above are put into force, the position of the agricultural colleges of Great Britain will be greatly strengthened, and they will be enabled to make a much greater contribution towards improving agricultural practice throughout the country.

International Longitude Operations

THE Observatory of Zi-Ka-Wei, which took part in the International Programme of Longitude Operations in October and November 1933, in addition to transmitting its results to the Commission of the International Astronomical Union responsible for the general reduction of the whole work, has published its own observations in its *Annales* (t. 20).

The Observatory kept its own time with two pendulums, Leroy 1227 and 1338, working at constant pressure and a temperature controlled by a thermostat. Meridian observations were made with two transit instruments, the Zi-Ka-Wei instrument used in 1926 and a similar instrument which was brought from Nice by M. Fayet. Observations with both instruments were secured on twenty-eight nights by four observers, each of whom used both instruments. The maximum difference between the clock errors deduced from the two instruments on the same night was $0{\cdot}04^s$, and the difference was generally less than $0{\cdot}02^s$. Wireless time signals were received from a number of stations, including DFY (Nauen) and FYL (Bordeaux). Time lags in the reception of the wireless signals were determined by a method due to M. Jouast, and it is hoped that their effect has been eliminated. The longitude of Zi-Ka-Wei minus Paris is found to be $7^h\ 56^m\ 21{\cdot}962^s$ in 1933, as compared with $21{\cdot}975^s$ in 1926. The difference between the two determinations is thus $0{\cdot}013^s$ (the equivalent of 17 ft. on the earth's surface) which is presumably scarcely outside the limit of accidental error; but it is of interest from the point of view of continental drift to note that observations of this kind would certainly have shown up a drift of seventy feet on the earth's surface during the seven years that elapsed between the two determinations. It is certain that the reality or otherwise of continental drift will be settled by these precise longitude observations, when a long enough time interval has elapsed.

The director of the Zi-Ka-Wei Observatory directs attention to a puzzling periodic variation from the mean longitude with an amplitude of $0{\cdot}05^s$ and period of one month. This is shown by the 1933 observations as well as by those made in 1926. He concludes that it is not possible to incriminate either the meridian observations or the reception of the time signals, and is inclined to attribute these fluctuations to a periodic deformation of the earth's crust. One is reminded of a somewhat similar effect in the longitude difference Washington minus Greenwich, which has been pointed out by Loomis and Stetson. The precise nature of the cause of this variation is obscure.

Biology and Variation of *Ceratium*

THE introductory report* (No. 1) to the Carlsberg Foundation's Oceanographical Expedition contains an article in memory of its late leader, Prof. Johannes Schmidt, by Martin Knudsen, with portrait, a foreword by P. Jespersen and Å. Vedel Tåning, a list of stations and, finally, the results with detailed tables of the echo-soundings, with introductory remarks by Sv. Greve. There are also seven maps showing the stations.

This was the last and the greatest of the many expeditions in which Schmidt personally took part, from June 14, 1928, until June 30, 1930. Like all those which he conducted, it was planned and conceived in every detail by himself. He took care that the investigations were as many-sided as possible, and maintained his interest in discovering connexions between the biological and physico-oceanographical conditions. The principal features in the biological-zoogeographical methods of work and the plans for the Expedition were drawn up by him in the following summary:—

(1) With the aid of the most efficient apparatus to obtain a very large material, rich in individuals, of the pelagic life in the different depths and the various oceans.

(2) With the aid of simultaneous, methodical investigations on the physical and chemical composition of the different water layers, to obtain data which would permit us to conclude under what environmental conditions each single one of the millions of pelagic organisms, taken in the nets, may live.

* The Carlsberg Foundation's Oceanographical Expedition round the World 1928–30 and Previous *Dana* Expeditions under the Leadership of the late Prof. Johannes Schmidt. Dana-Report No. 1. Introduction to the Reports from the Carlsberg Foundation's Oceanographical Expedition round the World 1928–30. Pp. 130+7 plates. 16*s*. net. No. 4. Untersuchungen über die Verbreitung, Biologie und Variation der Ceratien im südliches stillen Ocean, von E. Steemann Nielsen. Pp. 67. 8*s*. net. (Copenhagen: C. A. Reitzel's Forlag. London: Oxford University Press, 1934.)

(3) By means of the large pelagic material to subject a number of important oceanic species or genera to a finer analysis, with reference to classification, than has previously been possible with the frequently somewhat scanty material available from the distant waters.

The Expedition was successful in every way, and the results of the investigations now being published show its extreme value. It is to be regretted deeply that Schmidt did not live to see more of the fruits of his carefully planned work. The reports now being published are to appear in parts. No. 2 (Deep-Sea Angler Fishes (Ceratioidea)), by C. Tate Regan and Ethelwyn Trewavas, was published in 1932. Dr. Nielsen, who took part in the Expedition, now contributes an important monograph (No. 4) on the Ceratia in the southern Pacific Ocean. The genus is taken as representative of the phytoplankton and the whole work touches on many vital problems.

The *Ceratium* material is from two Danish Expeditions of the steamer *Dana*. In January 1922 in the Gulf of Panama and in September 1928–March 1929 on the present Expedition, through the Pacific Ocean from Panama to New Zealand–Australia, 68 stations were sampled, and in all the oceanic stations the Nansen closing net was used. Whilst on the first Expedition samples were taken at other depths, in 1928–29 the catches were almost wholly made at the depths 200–100 metres, 100–50 metres, 50–0 metres. The surface net was only used at shallow coastal stations where a vertical separation of species of *Ceratium* would be unimportant. Sixty species were recognised besides several sub-species and variations.

The larger part of these *Ceratium* species are oceanic, but a few are typically inhabitants of coastal waters, that is, neritic. The author's main conclusions are that temperature, currents and oceanic-neritic waters are the chief factors influencing the horizontal distribution of the *Ceratia*, the variation in the species depending on the first and the last. He finds that a rising temperature tends to lessen the size of the cell, and, in some species, there is a lengthening of the horns at the same time. Under a neritic influence the cells are usually large and there is almost always a lengthening of the horns. The case of *Ceratium fusus* is striking, for in neritic waters it is nearly double the size of that in purely oceanic conditions. The cause of this large size is evidently not the better nourishment of the cell, since the *Ceratium* population in the eutrophic east equatorial stream where the neritic influence is much felt are no greater than in the oligotrophic oceanic stations with the same surface temperature. The author is of the opinion that the dearth of *Ceratium* species in purely neritic waters compared with the large numbers in the oceanic stations is to be attributed to the accumulation of the waste products from the breaking down of the many organisms in neritic regions where the water is only renewed very slowly, these substances being usually poisonous to the sensitive oceanic species.

There is a striking agreement of the *Ceratium* populations in the Pacific and Atlantic Oceans, few species being peculiar to one or the other.

It is shown that the genus has a very characteristic depth distribution. About a third of those found in the Pacific are so-called 'shadow' species. In the plankton-poor water these were found chiefly in the samples below 50 metres, whilst most of those where the plankton was rich were chiefly above this depth. The 'shadow' species are all oceanic. They require only a moderate light intensity, but in those waters where there is abundance of plankton this moderate light intensity is nearer the surface. All *Ceratium* species which have a very broad flattened body or in some other way have the assimilation surface enlarged are 'shadow' species. In those regions where they live, the nutrient salts are always considerable.

Genetics at Cold Spring Harbor, N.Y.

THE latest annual report of Dr. C. B. Davenport for the Department of Genetics at Cold Spring Harbor is contained in Year Book No. 33 of the Carnegie Institution of Washington for 1934. It covers the usual wide range of investigations bearing on genetics in plants, animals and man. Only a few of these researches can be cited here. Demerec has surveyed the X-chromosome of *Drosophila* for minute deficiencies or cell-lethal mutations produced by X-rays. In 12 out of 13 cases the deficiency of a single locus caused cell death, which supports the view that nearly all the genes take a vital part in the functioning of every cell. In *D. virilis*, a gene producing intersexes has been found.

Blakeslee and Bergner find that, in *Datura discolor*, five of the twelve pairs of chromosomes have exchanged segments in comparison with *D. stramonium*, and these species when crossed give a ring of 10 chromosomes in the hybrid. Older seeds are shown by Cartledge to have a higher mutation rate than young seeds, and it was found that bad pollen could be used as an index of the mutation rate in aged seeds, which produced mutations at thirty times the rate of the controls.

Problems of leukæmia and immunisation in mice are investigated, and an account is given of Dr. Riddle's work on hormones, especially in pigeons. The antepituitary secretion has been most studied, both in pigeons and in cattle, some of the results receiving clinical application. It is shown that the gonad-stimulating hormone in rabbits also causes ovulation, but conclusive evidence is obtained that a separate pituitary principle stimulates the thyroid, also affecting the basal metabolism. The shaker mouse is found to show a defect in the *area striata* of the brain, and a circling mouse mutation is probably due to two recessive genes with variable expression. In the parasitic wasp, *Habrobracon juglandis*, Whiting has obtained sixty mutations. Some are sex-linked and form the basis for a theory of sex inheritance in this species with haploid males.

In human genetics there have been studies of growth in children, of the errors of physical anthropometry on the living subject, racial growth differences of Indians, Negroes and Dutch, and researches by Laughlin on immigration policy.

Educational Topics and Events

CAMBRIDGE.—The King has been pleased to approve the appointment of Dr. John Alfred Ryle to be regius professor of physic in the University in succession to Sir Walter Langdon Brown, who retires on September 30.

LIVERPOOL.—Dr. Hubert Horace Stones has been appointed Louis Cohen professor of dental surgery and director of dental education, from October 1 next, in succession to Prof. W. H. Gilmour, who retires at the end of the present session. Dr. Stones is an honorary dental surgeon to University College Hospital Dental School, London, and a research worker at the Hale Research Laboratory of the Royal Dental Hospital of London.

PROF. T. GRIFFITH TAYLOR, professor of geography in the University of Chicago, has been appointed professor of geography in the University of Toronto. This is the first independent chair of geography to be established in Canada. Dr. Taylor was associate professor of geography in the University of Sydney in 1920–28. He was senior geologist in Capt. Scott's last expedition to the south pole in 1910, and led other parties to the Antarctic in 1911–12.

EDUCATIONAL problems have in recent years engaged the attention of a multitude of investigators in the United States. In addition to the very numerous and comprehensive researches conducted by the staff of the Federal Office of Education, by State officials and by educational foundations, hundreds of systematic investigations have been carried out by candidates for the degree of doctor in education. A list of 797 theses submitted by such candidates and deposited with the Office of Education, where they are available for loan, has just been published by the Government Printing Office, Washington (pp. 69, price 10 cents). The titles are listed under a hundred subject headings arranged alphabetically, beginning with administration and ending with vocational guidance, with very full cross references under other headings. More than ten per cent of the theses are listed under the heading 'psychology'.

A DEPARTMENT of Business Administration was established at the London School of Economics in the University of London in 1930. Business men have from the outset played an active part in the work of the Department. At the end of the five-year experimental period, the Governors of the London School of Economics have decided, in view of the success which has attended the Department, to make it an integral and more permanent part of the work of the School. In that decision they are supported by the business men associated with the management of the venture. Several of the business firms which contributed towards the cost of the original experiment are generously continuing their financial support of the Department, and additional firms are also assisting. The active co-operation of business men in the actual conduct of the work is being continued in all its aspects, by the establishment of a Business Administrative Council of business men of widely diverse interests. A number of firms now favour the Department's University Scheme as a means of recruiting graduates. Some firms are in a position to offer appointments each year, others do so from time to time as vacancies occur. The post-graduate course of training, extending over one year of full-time study, remains the principal work of the Department. Students working for higher degrees, and wishing to undertake an investigation of a particular business problem as part of their work, may now combine attendance at the post-graduate course with their research. Particulars of the arrangements for the forthcoming session can be obtained from Prof. Arnold Plant, Department of Business Administration, London School of Economics, Houghton Street, Aldwych, London, W.C.2.

EDUCATIONAL broadcasting in the United States of America was discussed on May 15 at a conference called by the Broadcasting Division of the Federal Communications Commission. A statement made before the conference by the United States Commissioner of Education is reproduced in *School and Society* of June 15. It is remarkable for its insistence on the vital importance of safeguarding freedom of access to the microphone for exponents of all "the important ideas which struggle for acceptance in our complicated world order, so that our people can make intelligent choices in the determination of their destiny". The radio transmission systems in the United States being privately owned and operated, it is incumbent on the Federal Government to prevent their exploitation in the exclusive interests of any one body of doctrine and to ensure, on the contrary, the presentation of differing points of view in well-balanced programmes. With the progressive shortening of hours of labour in factories the field of influence of adult education by radio is rapidly expanding, and the Commissioner's announcement of his readiness to co-operate in a plan for the improvement of education by this means is timely. Much harm has been done by broadcasters imperfectly instructed in the technique of teaching by radio.

Science News a Century Ago

Death of Dr. John Brinkley, F.R.S.

ON September 14, 1835, Dr. John Brinkley, Bishop of Cloyne and Royal Astronomer of Ireland, died at his brother's house in Leeson Street, Dublin, at the age of seventy-two years. Born at Woodbridge, Suffolk, in 1763, he was enabled to enter Caius College, Cambridge, and in 1788 was senior wrangler and Smith's prizeman. While studying for his degree, he had assisted Maskelyne at Greenwich, and in 1790, largely through the influence of Maskelyne, he was chosen to succeed Henry Ussher as Andrews professor of astronomy in Trinity College, Dublin, and director of Dunsink Observatory, which had been erected under the superintendence of Ussher. A fine circle had been ordered for the observatory in 1785 from Ramsden, but this instrument was not completed until twenty-three years later, and Brinkley at first confined himself to mathematical work, contributing papers to the Royal Irish Academy and the Royal Society. On the erection of the 8-ft. circle at Dunsink he began researches on aberration and nutation, and made an attempt to determine the parallax of a fixed star. He also published his "Elements of Astronomy", which went through several editions, and his new theory of refraction, and computed the elements of the comets of 1819 and 1821. For this and other work he was made a vice-president of the Royal Society and president of the Royal Irish Academy, and in 1824 received the Copley Medal for his "Various Communications to

the Royal Society". Taking the degree of D.D. in 1806, he became prebendary of Kilgoghlin and rector of Derrybrush, in 1808 was made archdeacon of Clogher, and finally in 1826 bishop of Cloyne. His episcopal work from this time occupied much of his energy, and for the last ten years of his life he contributed little to science. He was buried in Trinity College Chapel, and a marble memorial to him was erected in Cloyne Cathedral. His best memorial, said Ball, was his admirable book on the "Elements of Plane Astronomy". He was succeeded in the Andrews chair by William Rowan Hamilton, whose genius he had long recognised.

Darwin in the Galapagos Archipelago

CHAP. xvii of Darwin's "Journal of Researches" contains his account of the visit of H.M.S. *Beagle* to the Galapagos Archipelago, the survey of which occupied from September 15 until October 20, 1835. "The archipelago," Darwin wrote, "consists of ten principal islands, of which five exceed the others in size. . . . They are all formed of volcanic rocks; a few fragments of granite curiously glazed and altered by the heat, can hardly be called an exception. Some of the craters surmounting the larger islands, are of immense size, and they rise to a height of between three and four thousand feet". Darwin landed on several of the islands of which, he said, the natural history is eminently curious and well deserving attention. "The archipelago is a little world within itself, or rather a satellite to America, whence it has derived a few stray colonists, and has received the general character of its indigenous productions. Considering the small size of these islands we feel the more astonished at the number of their aboriginal beings, and at their confined range. Seeing every height crowned with its crater, and the boundaries of most of the lava-streams still distinct, we are led to believe that within a period, geologically recent, the unbroken ocean was here spread out. Hence both in space and time we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth".

Green's Night in a Balloon

CHARLES GREEN (1785–1870), the first aeronaut to make an ascent with carburetted hydrogen gas, spent a night in the air on September 17, 1835. Writing to *The Times* on September 20, 1835, on his late aerial voyage from the Royal Gardens, Vauxhall, he said he ascended with Mr. Butler at quarter to six on Thursday evening, September 17, and at about quarter past six descended at Walthamstow. He then determined to stay in the air all night so, leaving Mr. Butler behind, he reascended, passed over Bishops Stortford, Royston and Huntingdon and at quarter to six on Friday morning landed in the parish of Wimbotsham, near Downham in Norfolk. He partook of an excellent breakfast at the residence of Mr. J. Pike. Then he again ascended and descended at 10.30 a.m. near Lynn, Norfolk. "I received numerous congratulations," he said, "though many persons I believe doubted the statement of my having been in the air during the past night. . . . I remained in the air altogether about 13 hours and from the zigzag direction of my course must have travelled about 130 miles. From the very trifling loss of power the balloon sustained during the whole of this time, I judge I might have remained up at least five days and nights."

Societies and Academies

PARIS

Academy of Sciences, July 22 (*C.R.*, **201**, 245–308). LOUIS BLARINGHEM: A new case of unilateral heredity observed on hybrids of sages (*Salvia nemorosa* × *S. Sclarea*). STANISLAS GOLAB: The relation between the ideas of measurements of angles and areas in Finsler spaces. ANDRÉ FOUILLADE: Unicity with a nearly constant factor, in an undecomposable ensemble, of a function of the ensemble invariant with respect to the transformation associated with a positive, linear functional transformation maintaining unity. JEAN BRAÏTZEFF: A particular case of the distribution of the singular points of a function defined by a Dirichlet series. MIÉCISLAS BIERNACKI: Some majorants of the theory of univalent functions. PAUL NOAILLON: Sudden expansion in a gas. MIROSLAV NÉNADOVITCH and MAURICE DENIS: Contribution to the experimental study of the stability of certain biplane cells at large incidences. P. CHEVENARD and X. WACHÉ: The accelerating effect of a sinusoidal mechanical tension on the changes in a hypertempered iron-nickel-chromium-carbon austenite. The accelerating effect of the sinusoidal pressure on the precipitation of the carbides is very marked. This results in a certain increase in the mechanical resistance when hot; but in some cases leads to fragility, giving rise to breakage without sensible deformation. RAYMOND TREMBLOT: A contrast star photometer. A modification of the Fabry and Buisson photometer without diffusing screens allowing a better utilisation of the light available when the measurements are carried out on point sources of light of very small luminosity. An accuracy of 0·01–0·02 magnitude is possible. ANDRÉ LÉAUTÉ: The capillary ascent of tars and bitumens. Application of the method previously described to the study of the causes of the changes in a road surface, originally satisfactory but later slippery. MME. LINA GUASTALLA: The oxido-reduction process at the level of a (kaolin) partition interposed in a copper solution, in the course of electrolysis. The factors determining the velocity of its appearance. MARCEL CAU and FÉLIX ESCLANGON: The coherence of light radiations and the possibility of using interference apparatus as monochromatic light sources. WITOLD BRONIEWSKI and W. LEWANDOWSKI: The influence of sulphur on the properties of copper. Amounts of sulphur varying from 0·0 to 0·7 per cent were added to copper, and measurements made of the changes in electrical conductivity, temperature coefficient of the electrical conductivity, thermo-electric power (against lead), breaking load, elastic limit, elongation before breaking and Brinell hardness. The results are given graphically. ROGER PERROT: The action of nitrosyl chloride on some silver salts. M. TIFFENEAU, P. WEILL, J. GUTMANN and B. TCHOUBAR: Molecular transpositions in the cyclane series. Lengthening and shortening of the rings. CHARLES DUFRAISSE and ANDRÉ ETIENNE: The dissociable organic oxides. The anthracene structure possesses reversible oxidisability: a dissociable oxide of mesodiphenylanthracene. From the study of the rubenes, the authors have deduced a structure for substances capable of reversible photoxidation, and mesodiphenylanthracene possesses such a structure. This substance has been found to absorb free oxygen, forming a crystallised photo-oxide: it dissociates at

200° C. into pure oxygen and the free hydrocarbon. ALBERT F. DE LAPPARENT: The Trias band of Barjols (Provence). JACQUES FROMAGET: The existence of the lower Trias with ocean facies to the south of Luang-Prabang (Laos) and on the palæogeography of south-eastern Asia at this period. CHARLES PÉREZ: Stages in the disappearance of the roots of *Peltogaster* after the fall of the visceral sac. PIERRE GRASSÉ and PAUL BONNEVILLE: Non-swarming imagos or achrestogonimes of the Protermitids. MARIUS BACCINO: The thermal adaptation of the nests of mammals during the growth of the young. The temperature of the nest in the case of rabbits falls as the age of the young increases. For each age there is a temperature of maximum growth. ALBERT and PAUL CHAUCHARD and MME. BERTHE CHAUCHARD: The action of nicotine on the preganglion and postganglion sympathetic nerve fibres. FRIEDRICH L. HAHN: The determination of very small quantities of ethyl bromide in biological media. ANDRÉ KLING, EMILE GELIN and JULES DEMESSE: The possible substitution, for the analysis of various natural plant products or their derivatives, of the determination of total carbon for that of the dry extract. The carbon dioxide obtained on oxidation with chromic and sulphuric acids gives a measure of the dry extract with sufficient approximation and offers a considerable saving in time. EDGAR LEDERER: Echinenone and pentaxanthine: two new carotinoids found in *Echinus esculentus*. A. BESREDKA, J. MAGAT and P. BESNARD: The vaccination of rabbits against cutaneous epithelioma. EMILE ROUBAUD and MARC TREILLARD: A coccobacillus pathogenic for tsetse flies.

GENEVA

Society of Physics and Natural History, July 4. E. BRINER, F. CHODAT and H. PAILLARD: The presence of ozone in the air, and its action on the growth of plants. B. SUSZ, E. PERROTTET and E. BRINER: Raman spectra and reactivity: eugenol, isoeugenol, vanillin and methyl derivatives, safrol, isosafrol, heliothropin, anethol and estragol. M. A. PUTNES: Stokes's theorem for heterogeneous ellipsoids in permanent rotation. R. WAVRE: Figures of equilibrium. K. H. MEYER and G. W. PANKOW: The chloride of polyphosphonitrile. P. WENGER, Ch. CIMERMAN and MLLE. C. RZYMOWSKA. The volumetric micro-estimation of potassium in blood serum. L. A. DESHUSSES and J. CORBAZ: (1) The fractionation of oily constituents by distillation. (2) The separation of oily constituents by extraction with ether. E. CHERBULIEZ and A. MIRIMANOFF: The differential estimation of the polypeptides and aminoacids of the serum by the use of ninhydrin. HELD and MLLE. PONSE: The thyreostimulating activity of the blood of thyroidectomised or normal guinea-pigs. F. WYSS-CHODAT. (1) Notes on transmissible microbial lysis. (2) The reducing power of milk. Reductase and coreductase. A. MIRIMANOFF: (1) The estimation of the aminoacids of the blood serum by tyrosinase. (2) Remarks on the growth factors of the must of grapes. E. BRINER, S. FRIED and B. SUSZ: The Raman spectra of solutions of pyrogallol, gallic acid and tannin. E. PITTARD: Intentionally broken teeth of the ox and horse of the Mousterian period. T. POSTERNAK: (1) The phosphorus of starch. (2) A new tetroxyadipic acid.

LENINGRAD

Academy of Sciences (*C.R.*, 2, No. 7, 1935). RENÉ CALAPSO: Configuration (T) of Finikoff and the projective elements attached to it. N. V. ADAMOV: Some conditions of stability. B. V. NUMEROV: Problem of the determination of systematic errors of star positions. D. N. CHRAMOV: Determination of anomalous values of the vertical gradient of gravity from the anomalies of gravity. E. M. BRUMBERG: A new method of producing monochromatic light. V. FREDERICKS, G. MICHAJLOV and D. BENESZEVICH: Dielectric losses in anisotropic fluids. B. I. DAVYDOV: Diffusion equation with reference to molecular velocity. A. G. SAMARCEV: Cathodic passivity of silver in solutions of silver nitrate. A. A. GRÜNBERG and L. M. WOLSTEIN: Mechanism of action of glycocol on potassium tetrachloroplatinate. I. N. EFIMOV: Modifications of facial conditions along the strike of the roofing of coal measures in the Donetz basin. A. A. PROKOFJEVA-BELGOVSKAJA: The structure of the chromocentre. S. G. LEVIT: Dominance in man.

SYDNEY

Royal Society of New South Wales, July 3. ADOLPH BOLLIGER: Volumetric microdetermination of magnesium with methylene blue following its precipitation as magnesium picrolonate. Magnesium, as well as calcium, forms a sparingly soluble picrolonate which, however, in contrast with calcium picrolonate, is not precipitated from dilute solutions at room temperature. However, magnesium salts were found to be precipitated quantitatively as magnesium picrolonate by heating and partially evaporating the solution in which they are contained. The analytical principle applied is as follows: a known excessive amount of lithium picrolonate is added to the aqueous solution containing the magnesium, precipitation is brought on by heating and evaporation, and the excess of picrolonate added is determined by titration with methylene blue. The limitations of the method are discussed. G. F. K. NAYLOR: Note on the geology of the Goulburn district, with special reference to Palæozoic stratigraphy. The first record of Lower Silurian strata in this State. These rocks were identified by their content of graptolites, a group of organisms the remains of which have also proved invaluable in determining the extent of the Upper Ordovician and Upper Silurian strata in the same district. The author shows that, on palæontological and structural evidence, the Palæozoic strata near Goulburn form a broad synclinal structure, the core of which is occupied by the Upper Devonian mass of the Cookbundoon Mountain, and the hill on which the Goulburn War Memorial is situated.

VIENNA

Academy of Sciences, July 4. ERNST SPÄTH and FRIEDRICH BECKE: Cactus alkaloids (15). Separation of anhalonium bases. GUIDO MACHEK: Action of aromatic sulpho- and oxysulpho-acids on α- and β-amino acids. ERNST FÖYN, ELISABETH KARA-MICHAILOVA and ELISABETH RONA: Artificial transformation of thorium by neutrons (1). GUSTAV ORTNER and RICHARD ZENTNER: Measurement of the natural breadths of X-ray lines. The possibilities of using a single-crystal spectrometer for measuring these breadths photographically were investigated.

ELVIRA STEPPAN: Problem of the disintegration of aluminium, treated by the photographic method. JOSEF SCHINTLMEISTER: The question of the existence of unknown natural α-rays. These rays, of range $R_{15} = 2{\cdot}2$ cm., occur always in conjunction with samarium and exhibit marked chemical affinity with this element. The carrier of the activity observed is most probably thulium or, at any rate, element No. 61. HEINRICH MACHE and GEORG MARKSTEIN: Output of emanation to water flowing over radium-containing rocks. The view has been expressed that, owing to the slight capacity of rocks for occluding indifferent gases, the quantity of emanation passing into spring water per unit of time and per unit of rock-surface must be independent of the concentration of the emanation present in the water. Experimental results now obtained agree with this view. RUDOLF KANITSCHEIDER: Terrestrial magnetic observations of the Austrian Polar Expedition to Jan Mayen, 1932–33. The results obtained for 1933·0 are: declination, − 22° 40′; horizontal intensity, 11,700γ; vertical intensity, 50,400 γ. H. L. WERNECK: Phenology of Upper Austria, 1926–30. OTTO FÜRTH and HEINZ HERRMANN: Colour reactions of tartaric, citric and aconitic acids. When heated with pyridine and acetic anhydride, citric acid gives a carmine, aconitic acid a violet-red, and tartaric acid an emerald-green coloration. J. P. REIMER: Nebulæ in the region of *o*-Persei. HANS KRUMPHOLZ: Course of the brightness of Nova (1934) Herculis to the beginning of April 1935. FRANZ RINAGL: Flow limits and bending. ARMIN DADIEU and WOLF ENGLER: Raman spectra of C_2H_5SeH and C_2H_5SeD. The frequencies for the SeH − (2303 cm.$^{-1}$) and SeD − (1665 cm.$^{-1}$) vibrations agree well with those previously found for SeH_2 (2313 cm.$^{-1}$) and SeD_2 (1665 cm.$^{-1}$). ARMIN DADIEU and OTTO KERMAUNER: Structure of half-heavy acetylene. Comparison of the Raman spectra of C_2H_2, C_2D_2, and a product obtained from CH·CNa and D_2O indicates that this product contains about 50 per cent of C_2HD, with 25 per cent each of C_2H_2 and C_2D_2. The product of the reaction of C_2Na_2 with a mixture of D_2O and H_2O in equal proportions gives a spectrum identically the same. ALFONS KLEMENC, R. WECHSBERG and G. WAGNER: Preparation of carbon suboxide. The separation of carbon suboxide from its mixture with carbon dioxide and keten, obtained from diacetyltartaric anhydride, is described. MORITZ KOHN: Action of oxalates on blue iron-cyanogen compounds. OTTO DISCHENDORFER and AUGUST VERDINO: 2:6-Dibenzoylhydroquinone. K. W. F. KOHLRAUSCH and GR. PRINZ YPSILANTI: Raman effect (45). Raman spectrum of organic substances (polysubstituted benzenes, 7). The substances examined were of the type, $X.C_6H_4.OCH_3$, where X = NH_2, OH, CH_3, F, Cl, Br, I, or CN. A. PONGRATZ and R. SEKA: Raman spectra of benzenepolycarboxylic esters. Methyl and ethyl iso- and tere-phthalates, and trimethyl benzene-1:2:3-tricarboxylate were examined. The C–C ring linkings behave similarly to those in open-chain unsaturated compounds. K. W. F. KOHLRAUSCH and W. STOCKMAIR: Raman spectra of nucleus-substituted ethyl benzoate. The substituents were NH_2, OH, Cl, Br, NO_2. EUGEN GUTH: Theory of the scattering of charged particles at atomic nuclei (with a special application to the scattering of protons at protons). KARL SCHWARZ: Transport number and valency of silver in silver amalgam. VICTOR F. HESS: Daily course of cosmic ultra-radiation. Wagner's criticisms are discussed.

Forthcoming Events

IRON AND STEEL INSTITUTE, September 16–18. Autumn meeting to be held in Manchester.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX, September 20–23.—Annual conference to be held in St. John's College, Cambridge.

Sir Richard Gregory: "Interpretation of Science" (Presidential Address).

Official Publications Received

Great Britain and Ireland

Scottish Society for Research in Plant Breeding. Report by the Director of Research to the Annual General Meeting, 25th July, 1935. Pp. 29. (Edinburgh: Scottish Society for Research in Plant Breeding.)

Queen Mary College (University of London). Calendar, Session 1935–1936. Pp. 260. (London: Queen Mary College.) 1*s*.

Proceedings of the Royal Irish Academy. Vol. 42, Section A, No. 3: A New Method for counting Atmospheric Ions and determining their Mobilities. By J. J. Nolan and P. J. Nolan. Pp. 15–19. Vol. 42, Section A, No. 4: Vortex Polygons. By W. B. Morton. Pp. 21–29. 1*s*. Vol. 42, Section No. 5: The Faraday Dark Space. By K. G. Emeleus. Pp. 31–36, Vol. 42, Section B, Nos. 10, 11, 12: The Physiological Basis of the Sensation of Cold. 1: The Influence of the Initial Skin Temperature on the Excitability of the Cold Eng Organs, by J. M. O'Connor; 2: The Analogy between Human Cold Sensations and Shivering in the Rabbit, by J. M. O'Connor, M. Moriarty and O. Fitzgerald; 3: the Influence of the Body Temperature on the Resting Oxygen Consumption—A Metabolic Analogy to Cold Sensations, by J. M. O'Connor. Pp. 327–357. 1*s*. Vol. 42, Section B, No. 13: Some 2.4.Derivatives of Thiophene. By R. O. Cinnéide. Pp. 359–363. Vol. 42, Section B, No. 14: Excretion of Glucose by the Rabbit Kidney. By T. W. T. Dillon and R. O'Donnell. Pp. 365–405. 1*s*. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

London County Council. Lectures and Classes for Teachers: Handbook for the Session 1935–36. Pp. 83. (London: London County Council.)

Sixth Report on the Heterogeneity of Steel Ingots: being a Report by a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation to the Iron and Steel Industrial Research Council. (Special Report No. 9.) Pp. vi+236+37 plates. Waste-Heat Boilers in Open-Hearth Practice: Second Report of the Open-Hearth Committee, being a Committee of the Iron and Steel Industrial Research Council. (Special Report No. 10.) Pp. iii+73+2 plates. (London: Iron and Steel Institute.)

Other Countries

U.S. Department of the Interior: National Park Service. Fauna of the National Parks of the United States: Wildlife Management in the National Parks. By George M. Wright and Ben H. Thompson. (Contribution of Wildlife Division, Fauna Series, No. 2.) Pp. viii+142. (Washington, D.C.: Government Printing Office.) 20 cents.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 146: Egyptian Plant Diseases, a Summary of Research and Control. By G. Howard Jones. Pp. v+45+8 plates. 5 P.T. Bulletin No. 152: An Analysis of the Factors governing the Response to Manuring of Cotton in Egypt. By David S. Gracie and Dr. Fahmy Khalil, in collaboration with Hussein Enan. Pp. v+71+12 plates. 10 P.T. (Cairo: Government Press.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 94, Partie 1: Procès-verbaux (Mai 1935). Pp. 55. 3.00 kr. Vol. 94, Part 3: Appendices (1934–1935). Pp. 77. 3.50 kr. (Copenhague: Andr. Fred. Høst et fils.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 55: The Selection, Preservation, Distribution and Identification of Australian Pole Timbers. By J. E. Cummins and H. E. Dadswell. (Division of Forest Products: Technical Paper No. 17.) Pp. 79+7 plates. Pamphlet No. 57: Tests of the Efficacy of the Oxy-Acetylene Scouring and Charring Process for Sterilising Partly Decayed Poles. By J. E. Cummins. (Division of Forest Products: Technical Paper No. 18.) Pp. 43. (Melbourne: Government Printer.)

Forest Department: Trinidad and Tobago. Leaflet No. 6: Notes on Insect Attack on Mora (*Mora excelsa* Benth.) in Trinidad. By C. Swabey. Pp. 39. (Trinidad: Government Printing Office.) 6*d*.

Ingeniørvidenskabelige Skrifter. A, Nr. 39: A New Device for Direct Stream Field Studies and its Application; with an Appendix on the Pressure Distribution on a Triangular Prism. By Paul Neményi. Pp. 23. (Copenhagen: G. E. C. Gad.) 3.00 kr.

Journal of the Indian Institute of Science. Vol. 18A, Part 11: Hydrogen Ion Concentration of Lead Solutions. By D. N. Mehta and S. K. Kulkarni Jatkar. Pp. 75–83. 14 annas. Vol. 18A, Part 12: Studies in Antimony Electrode. By D. N. Mehta and S. K. Kulkarni Jatkar. Pp. 85–100. 1.4 rupees. Vol. 18A, Part 13: pH Control of Rotary Drilling Fluids. By D. N. Mehta and S. K. Kulkarni Jatkar. Pp. 101–107. 12 annas. (Bangalore: Indian Institute of Science.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 152: An Analysis of the Factors governing the Response to Manuring of Cotton in Egypt. By David S. Gracie and Dr. Fahmy Khalil, in collaboration with Hussein Enan. Pp. iii+71+12 plates. (Cairo: Government Press.) 10 P.T.