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The Revolt against the Teaching of Evolution in the United States.

THE movement in some of the Southern and Western United States to suppress the teaching of evolution in schools and universities is an interesting and somewhat disconcerting phenomenon. As it was I who, all unwittingly, dropped the spark which started the fire, I welcome the invitation of the Editor of NATURE to comment on the consequences.

First as to my personal share in the matter. At the Toronto meeting of the American Association I was addressing a scientific gathering, mainly professional. The opportunity was unique inasmuch as the audience included most of the American geneticists, a body several hundreds strong, who have advanced that science with such extraordinary success. I therefore took occasion to emphasise the fact that though no one doubts the truth of evolution, we have as yet no satisfactory account of that particular part of the theory which is concerned with the origin of *species* in the strict sense. The purpose of my address was to urge my colleagues to bear this part of the problem constantly in mind, for to them the best chances of a solution are likely to occur. This theme was of course highly academic and technical. Nevertheless, to guard against misrepresentation, I added the following paragraph by the advice of a friend whose judgment proved sound, though to me such an addition looked superfluous.

"I have put before you very frankly the considerations which have made us agnostic as to the actual mode and processes of evolution. When such confessions are made the enemies of science see their chance. If we cannot declare here and now how species arose, they will obligingly offer us the solutions with which obscurantism is satisfied. Let us then proclaim in precise and unmistakable language that our faith in evolution is unshaken. Every available line of argument converges on this inevitable conclusion. The obscurantist has nothing to suggest which is worth a moment's attention. The difficulties which weigh upon the professional biologist need not trouble the layman. Our doubts are not as to the reality or truth of evolution, but as to the origin of *species*, a technical, almost domestic, problem. Any day that mystery may be solved. The discoveries of the last twenty-five years enable us for the first time to discuss these questions intelligently and on a basis of fact. That synthesis will follow on analysis, we do not and cannot doubt."

The season must have been a dull one, for upon this rather cold scent the more noisy newspapers went off full cry, with scare-headings "Darwin Downed," and the like.

All this seemed foolish enough, and that practical consequences would follow was not to be expected. Nevertheless, Mr. William Jennings Bryan, with a profound knowledge of the electoral heart, saw that something could be made of it and introduced the topic into his campaign, which, though so far harmless in the great cities, has worked on the minds of simpler communities. In Kentucky a bill for suppressing all evolutionary teaching passed the House of Representatives, and was only rejected, I believe, by one vote, in the Senate of that State. In Arkansas the lower house passed a bill to the same effect almost without opposition, but the Senate threw it out. Oklahoma followed a similar course. In Florida, the House of Representatives has passed, by a two-thirds vote, a resolution forbidding any instructor "to teach or permit to be taught Atheism, agnosticism, Darwinism, or any other hypothesis that links man in blood relation to any form of life." This resolution was lately expected to pass the Senate. A melancholy case has been brought to my notice of a teacher in New Mexico who has been actually dismissed from his appointment for teaching evolution. This is said to have been done at the instigation of a revivalist who visited the district, selling Mr. Bryan's book.

The chief interest of these proceedings lies in the indications they give of what is to be expected from a genuine democracy which has thrown off authority and has begun to judge for itself on questions beyond its mental range. Those who have the capacity, let alone the knowledge and the leisure, to form independent judgments on such subjects have never been more than a mere fraction of any population. We have been passing through a period in which, for reasons not altogether clear, this numerically insignificant fraction has been able to impose its authority on the primitive crowds by whom it is surrounded. There are signs that we may be soon about to see the consequences of the recognition of "equal rights," in a public recrudescence of earlier views. In Great Britain, for example, we may witness before long the results which overtake a democracy unable to tolerate the Vaccination Act, and protecting only some 38 per cent of its children.

As men of science we are happily not concerned to consider whether a return to Nature, as a policy, will make for collective happiness or not. Nor is it, perhaps, of prime importance that the people of Kentucky or even of "Main Street" should be rightly instructed in evolutionary philosophy. Mr. Bryan may have been quite right in telling them that it was better to know "Rock of Ages" than the ages of rocks. If we are allowed to gratify our abnormal instincts in the search for natural truth, we must be content, and we may be thankful if we are not all hanged like the Clerk of Chatham, with our ink-horns about our necks.

For the present we in Europe are fairly safe. A brief outbreak on the part of ecclesiastical authority did follow the publication of the "Origin of Species," but that is now perceived to have been a mistake. The convictions of the masses may be trusted to remain in essentials what they have always been; and I suppose that if science were to declare to-morrow that man descends from slugs or from centipedes, no episcopal lawn would be ruffled here. Unfortunately the American incidents suggest that our destinies may not much longer remain in the hands of that exalted tribunal, and that trouble may not be so far off as we have supposed. W. BATESON.

The Unity of Anthropology.

Die Kultur der Gegenwart: ihre Entwicklung und ihre Ziele. Herausgegeben von Paul Hinneberg. Dritter Teil: Mathematik, Naturwissenschaften, Medizin. Fünfte Abteilung: Anthropologie. Unter Leitung von G. Schwalbe und E. Fischer. Pp. viii + 684 + 29 Tafeln. (Leipzig und Berlin: B. G. Teubner, 1923). *22s. 7d.*; cloth, *27s. 4d.*

ANTHROPOLOGY, the science of man—a proud name indeed! But, alas, there is little at present but the name which stands for the unity of this science. Its subject matter it has to share with anatomy, biology, theories of heredity and variation, geology, sociology, and social psychology. Its methods are borrowed from several natural and humanistic sciences. Its aim and scope seem at first but arbitrarily claimed and loosely circumscribed by man's excessive conceit about his own importance as a central object of study. After all, man is physically but one animal species among others, while his soul has been for a long time already in the keeping of another science—that of psychology.

The unfortunate fact is that man has been created with a body and a soul as well, and this original sin, after having incessantly haunted the reflective mind through myth, religion, theology, and metaphysics, comes now to lay its curse on anthropology. Physical and cultural anthropology are divided by the deep rent between soul and body, matter and mind, which is no easier to bridge over in science than in the somewhat looser speculations which precede it.

An anthropologist has to be a Jack-of-all-trades as matters now are, however much he may deplore it, and he needs a good handbook of his science, wherein to store that part of his stock in trade which is not kept fresh by constant handling in his own specialist's

workshop. Until the appearance of the present volume there was no satisfactory manual covering the whole field, or rather the several plots embraced by the name Anthropology. In a science where real unity is impossible, no one can specialise in all its branches. Collaboration is the only way of dealing with each subject in an adequate manner; and no better or more competent collaborators could be found than the six German savants whose names figure here on the title-page.

The handbook is the fifth part of the section devoted to natural science in the monumental series which is being published under the title "Die Kultur der Gegenwart" by B. G. Teubner, and aims at an exhaustive statement of the present state of knowledge. It commands real admiration to see how this extremely ambitious, yet thoroughly adequate, scheme is being carried out, in spite of the interruption caused by the War, in spite of the hard economic struggle which the academic classes in Germany have to face, in spite of the critical state of the publishing trade in that country.

There is first in this volume a short introductory chapter by Prof. E. Fischer, giving a systematic initiation into the subject, a clearing up and ordering of the field, so dear to the methodical mind of the German, and, to tell the truth, so extremely important and useful in a manual. In this case, the introduction is written with a strong somatological bias, and treats the cultural side of our science in a rather step-motherly manner. The history of anthropology, for example, contains no reference to any of the great pioneers of cultural anthropology; the names of Bastian, Tylor, Frazer, Durkheim are not even mentioned. On the whole, it is the least satisfactory section of the book. There follow four parts exclusively devoted to physical anthropology: Part II., on Measurements, by Prof. Th. Mollison; Part III., Somatology, by Prof. E. Fischer and Th. Mollison; Part IV., the Human Races, by Prof. Fischer; Part V., the Theory of Human Descent, by the late Prof. G. Schwalbe. These parts are all one could wish for—clear, concise, up-to-date, exhaustive. The next part is an account of prehistoric anthropology by the late Prof. M. Hoernes. This part is naturally divided between the fields of physical and cultural anthropology. Only the last two of the eight essays belong entirely to the other—to the social, or cultural aspect of anthropology. Of these the one is an account of ethnology, by Dr. F. Graebner. The other, entitled "Sozialanthropologie," and written by Prof. A. Ploetz, is a very suggestive but as yet only tentative attempt at a correlation of race with cultural achievement, an attempt to construct a theory of the organising and civilising values of each of the several varieties of mankind.

Two of these essays will be of special interest, for they are not only the last word of science on the subject of pre-history and theory of descent, but they are also the last contribution of two very eminent scholars, Prof. Hoernes and Prof. Schwalbe, both of whom died while the book was in the publisher's hands.

On the whole, the volume will be of great use as a handbook specially to the social anthropologist—using this word in the English sense—just because the physical branches have been worked out at a greater length and in a more final and authoritative manner. Now naturally, if you are an anthropologist specialised in a corner of your field, you need to have the other plots well mapped out. In your own little plot you ought to find your way without a map!

Nor is it possible in the present state of cultural anthropology to give a final and entirely impartial statement of its results. For its methods, its aim, and its subject matter are in a flux, and there is very little agreement even on points of fundamental importance. As is well known, the value of the old evolutionary theories is being vigorously contested, while there is a great deal of dissension and confusion about the place of "psychological," "historical," and "sociological" explanations. Dr. Graebner is one of the pioneers of the "historical" school and its ablest exponent in Germany. This school concentrates its attention on the analysis of "cultural complexes," on the diffusion of institutions, customs, and cultural objects, and on the mechanism of culture-contact.

Many anthropologists in Great Britain will no doubt be interested in Dr. Graebner's essay—both those who wish to see perhaps the most exhaustive account of their own point of view extant, and those who wish to have a clear statement for criticism.

Dr. Graebner states his case in an introductory discussion of the aims of ethnology (pp. 445-447) and in a final summing up (pp. 572-583). The body of the essay contains first the analysis of the various cultures of humanity—savage, barbarous, and civilised. In the second main section there is an account of the evolution of the various elements of culture—clothing and ornaments, housing, economics, technology, trade and communication, social organisation, art and knowledge. This part is extremely interesting, for it shows very forcibly how fruitful and interesting evolutionary theories can be when based on a conception of humanity, divided into a number of cultural types and not lumped together into one homogeneous whole. Dr. Graebner's essay might go very far towards the clearing up of misunderstandings, convincing the intransigent opponents of the historical school, and, last though not least, towards the levelling up of the sharp rift which now divides the cultural and evolutionary schools in England, Germany, and the United States.

The essay, it seems, was practically finished before the War, and this explains why the work of Dr. Rivers finds only a subordinate place, while the still more radical and extremely interesting theories of Prof. Elliot Smith and Mr. Perry are not even mentioned. The work of Prof. A. R. Brown of Cape Town on the Andaman Islanders, easily the best contribution of the youngest generation of field anthropologists and very important in its bearing on the Negrito culture, came out too late to be considered. Had Dr. Graebner been able to incorporate the views of these scholars in his essay, this would have become of still greater value to modern ethnology.

Returning now to the question raised at the outset, that, namely, of the unity of anthropology, it is clear that this work reflects the present state of affairs as well as the prevalent tendencies: a deep rent between the physical and cultural branches; a preponderance given to the physical ones; and, within the cultural branches, an attitude of hostility to psychology and evolution.

On these lines, however, anthropology certainly will never attain its desired unity. For, first of all, so-called physical anthropology is not a new science or a new method or a new point of view. "We have to regard anthropology as nothing else but a comparative anatomy of man" (Prof. Schwalbe, p. 227). Nor is it easy to see how and where such comparative anatomy can establish any direct connexion with the study of human culture, or help in the understanding of social organisation, custom, and tradition. The only point where cultural anthropology needs the assistance of the naturalist is in the classification of the several varieties of mankind. Even here, comparative anatomy has already given us apparently all it could, which has been of great value indeed. But now, it is from biology, mainly from theories of natural selection, variation, and Mendelism, that we can hope for effective contributions to progress. Thus physical anthropology is not a new or independent science, but the application of several natural studies to the problem of varieties of man. Nor can physical anthropology ever be capable of throwing light on the relevance of these varieties. For a human race does not interest us as a mere class of animals, but only in so far as it is a substratum for a definite type of civilisation.

The study of civilisation—"cultural" or "social" or "psychological anthropology"—is the only science which can take the lead in the organising of anthropological problems, for it studies that which is of primary interest to us in Man: his mind, his creative power, and his social tradition. Cultural anthropology is, moreover, an entirely new branch of learning. Its field-work, the observations on the customs, social organisation, and mentality of natives, must be done by specialists possessing certain particular aptitudes as well as an appropriate training. The theory of cultural anthropology has also to elaborate its own methods, which it can borrow from nowhere else and share with no other study.

An empirical proof of this far wider scope of cultural as against physical anthropology can be found in the history of modern field-work and theory. Sir Baldwin Spencer, a distinguished zoologist who took up field-work late in life, was gradually drawn into exclusively social and cultural studies, and in his latter researches did not trouble about any measurements or somatological observations, while he concentrated exclusively on his remarkable researches into the ideas and institutions of the Australian aborigines. Dr. Rivers, a neurologist, physiologist, and medical man, who in his earlier field-work still made some anatomical and physiological observations, gave them up entirely, as irrelevant, in his latter explorations in Melanesia, in which he has created a new type of cultural research. In the work of Dr. Haddon and Prof. Seligman, again one a zoologist and the other a medical man, physical anthropology plays an entirely subordinate part, although neither of them has given up somatology altogether. Again in theory, we see how a distinguished anatomist, Professor Elliot Smith, who became interested in ethnology through anatomical observations, has been drawn, in his ethnological work, entirely into sociological, cultural, and psychological research.

Not that cultural anthropology should ever become independent of the naturalist's help or give up its foundations of zoological science. Only it appears that it will have to turn to the study of life and function rather than that of bones, muscles, and structure. The biometrical line of research, the work done by the Eugenic Society, the applications of Mendelism to anthropology seem all to be symptoms and promises of extremely interesting results to follow. It is undoubtedly a pity that some of the results already obtained by these studies could not be incorporated in this manual. They certainly indicate much more promising and important lines of junction between the theory of organic nature and that of culture than those on which was based the old loveless and sterile marriage between anatomical description and psychological guesswork. For the psychology which is needed in modern anthropology is no more the old associationist and introspective empiricism, but biological psychology founded on a comparative study of instinct and largely inspired by the study of animal behaviour, the child's development, mental disorders, the analysis of dreams and of the structure of language.

In all these applications, the guiding and selecting initiative must come from the direct study of culture. On these lines and on these lines only the new anthropology can hope to ripen in the future to an independent, self-contained, and sovereign study with a firm basis in biological science, itself a solid bridge between humanism and natural history. But this is only a hope and a forecast! Much work will have to be done yet, and in this, the present volume, an excellent summary of the actual state of our science will be of great help and value. B. MALINOWSKI.

Sexual Physiology.

The Physiology of Reproduction. By Dr. Francis H. A. Marshall. Second and revised edition. Pp. xvi + 770. (London: Longmans, Green and Co., 1922.) 36*s*. net.

WITH the gradual rise of the experimental school in biology, and with the increasing demand for scientific method in veterinary and medical practice, the existence of a definite gap in scientific literature came to be recognised. Nowhere was the subject of the physiology of reproduction dealt with at all adequately; in the ordinary text-book of physiology it was dismissed after a very superficial treatment. Moreover, there was not a physiologist competent to write upon this subject at all authoritatively. Biologists, pure and applied, owe a great debt of gratitude to Dr. Marshall for having chosen this field in which to work; for, thanks to his labours, the difficulties of a great band of research workers have been made much less complex.

The second edition of this comprehensive text-book on sexual physiology maintains the reputation so readily secured by its predecessor, published thirteen years ago and long since out of print. It is born into a world somewhat different from that in which the first edition played its part so well; the specialities have become so fragmented that to-day no one book on this subject can hope to satisfy the demands of such varied interests as those of the experimental biologist, the cytologist, the embryologist, the psychologist, the geneticist, the veterinarian, the obstetrician, and the eugenist. Each no doubt will discover disappointing omissions and conclude that his own particular interest has been somewhat neglected; yet it cannot be denied that the book remains the only common meeting-ground for all those who are working on the general subject of the physiology of reproduction. It is a most admirable book of reference for the specialist in one branch who wishes to examine his conclusions in the light of the work of others, while to the student of biology at the beginning of his career it will prove a veritable mine of information and a great stimulus to his scientific curiosity, for in its pages a hundred and one problems, all urgently demanding further investigation, are suggested. When it is remembered that Dr. Marshall reviews the work of some fourteen hundred investigators, that for the exposition of the subject-matter nearly eight hundred pages are required, and that for the making of the book the collaboration of four specialists was demanded, an idea of the immense amount of research that has been and is being done in this most important subject will be gained.

Dr. Marshall himself is responsible for the chapters dealing with the breeding season, the œstrous cycle, the œstrous changes in the non-pregnant uterus and in the ovary, gametogenesis, the accessory sexual apparatus, the endocrine function of the gonads, parturition, lactation, fertility, sex-determination, and the phases in the life of the individual. Dr. Cramer has revised and partly rewritten his section on the biochemistry of the sexual organs, and has also revised that originally contributed by Dr. Lochhead on the changes in the maternal organism during pregnancy. Dr. Lochhead's other sections on fœtal nutrition and on the physiology of the placenta, owing to the author's absence from Great Britain, unfortunately have not been revised.

The least satisfactory part of the book, both as regards arrangement and subject-matter, is, we think, that contributed by Dr. Cresswell Shearer on fertilisation. It begins with a section on the oxidation processes in the ovum on fertilisation and during development; it concludes with one on parthenogenesis, natural and artificial, in which the actual processes which initiate cleavage are discussed; while between the two we find, *inter alia*, under "The hereditary effects of fertilisation" a quite unnecessary statement of Weissmann's speculations grafted gratuitously on to an elementary exposition of Mendelism. In this the author, apparently through an inadequate comprehension of the chromosome hypothesis, devotes a considerable amount of space to tilting at windmills of his own creation without attempting to initiate the reader into the actual facts which have been demonstrated by Morgan and his school. Surely, if it was not the author's purpose to deal with experimental genetics, it would have been better to have omitted all reference to the subject than to have detailed a nomenclature which is of historical interest only and to have criticised hypotheses of which the significant data are not mentioned. But, as we have said, no specialist will find his own peculiar interest satisfactorily treated in this book: the obstetrician will complain that the phenomena connected with the function of reproduction in the human subject do not meet with the treatment that they deserve, the psychologist will perhaps disagree with

Dr. Marshall's choice of his authorities in this particular field, but each must remember that this book has been written not for one interest but for all that are concerned with the physiology of reproduction.

As it stands, the book is the best treatise on the subject that we have, and it is because it is so good and so valuable that its beneficiaries are so concerned in its further development. It must remain the best book on the subject and a memorable contribution to British scientific literature. F. A. E. C.

Applied Organic Chemistry and International Trade.

(1) *Synthetic Colouring Matters: Vat Colours.* By Prof. Jocelyn Field Thorpe and Dr. Christopher Kelk Ingold. (Monographs on Industrial Chemistry.) Pp. xvi+491. (London: Longmans, Green and Co., 1923.) 16*s.* net.

(2) *Dyes and their Application to Textile Fabrics.* By A. J. Hall. (Pitman's Common Commodities and Industries.) Pp. ix+118. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) 3*s.* net.

(3) *Handbuch der biologischen Arbeitsmethoden.* Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 84. Abt. I: *Chemische Methoden.* Teil 10, Heft 3: *Spezielle chemische Methoden. Harze und Pflanzenfarbstoffe.* Pp. 585-832+xxii. (Berlin und Wien: Urban und Schwarzenberg, 1922.) 10.5 Schw. francs.

DURING the period which has elapsed since the Armistice, events in the domain of international trade confirm the belief engendered by the War that the manufactures based on applications of organic chemistry are among the most important of our key industries. The pre-War dependence on German sources for the supply of fine chemicals was a national menace, which has since been largely obviated by the creation of a new industry in organic chemicals entirely unprecedented in the annals of the British Empire. A remarkable achievement standing to the credit of the manufacturers of synthetic dyes and intermediates may be appreciated by the circumstance that whereas in 1914 eighty per cent. of these colours used in Great Britain were of German origin and only twenty per cent. of home production, nowadays these proportions are reversed, British makers accounting for eighty per cent. of the total supply, the remainder coming from abroad, and at present more from Switzerland than from Germany.

In regard to certain complicated colours, such as the vat dyes, now being produced for the first time in Great Britain, it is generally admitted by dye users that the quality is well up to continental standards, but a difficulty arises in the matter of cost of production. Owing to the disparity between the exchanges this cost is far lower in Germany than in Great Britain. A vat dye put on the market by British makers at four or five shillings per pound can be sold with profit for the same number of pence by the German producers. It should be obvious that without the partial protection afforded by the Dyestuffs Act the British manufacturers must get the worst of this unfair competition. The closing down of our newly established works in dyes and intermediates would, however, mean "Never again" in a sense very different from that in which this patriotic exclamation was uttered in 1914. The value of a home supply of dyes has already been clearly demonstrated since the French and Belgian occupation of the Ruhr rendered very uncertain the importation of German colours even under licence.

(1) The monograph on vat colours by Prof. Thorpe and Dr. Ingold deals with an important group of dyes which are among the most durable and brilliant of colouring matters. This group includes not only the long-known dyes, indigo and Tyrian purple, but also several series of new colours discovered during the present century. These dyes have highly complicated chemical structures and are produced by difficult operations taxing to the utmost the skill and ingenuity of scientifically trained industrialists. It is noteworthy that vat dyes are now being manufactured by at least three British firms, and the chemists engaged in this industry have not only copied very successfully the German types, but also have placed on the market several entirely new and valuable vat colours. The monograph now under review, which arrives at a crucial time in the history of British chemical industry, is the first English treatise dealing with this intricate group of synthetic dyes.

(2) Mr. Hall's handbook, which is one of a series dealing with common commodities and industries, is written for the non-technical reader and is intended to give him a comprehensive view of the dye and dyeing industries. In an outline of the development of the dye industry it is significant to note the opening sentence of the first letter which ever passed between a dye user and a synthetic dye maker. Messrs. Pullar, writing to the discoverer of mauveine in 1856, stated, "If your discovery does not make the goods too expensive it is decidedly one of the most valuable that has come out for a very long time." This matter of cost is still a burning question between makers and users, and the presence in allied and neutral countries of parcels of dirt-cheap German dyes tends to make our dyers and printers chafe against the restrictions imposed under the Dyestuffs Act. But since the principal Rhenish dye factories are within the allied spheres of occupation, it should not be impossible to make fiscal arrangements

whereby this fraudulent undercutting could be prevented.

(3) The researches on synthetic dyes have not engrossed the attention of continental chemists to the exclusion of the study of natural colouring matters, and the present monograph, well printed on paper of pre-War quality, is a good indication of the interest taken by Swiss chemists in the border-line science of biochemistry. The subjects dealt with include a summary of the methods employed in obtaining balsams and resins and in subjecting these materials to systematic decompositions. The appropriate methods of proximate analysis are also indicated. The larger section of the work is devoted to the identification and preparation of the most important vegetable colouring matters. The detailed information supplied on this abstruse subject is supplemented by many references to original memoirs, and there is an adequate index. The brochure is the eighty-fourth section of the comprehensive handbook of experimental methods in biology being issued under the editorship of Dr. Emil Abderhalden, the well-known physiologist.

Relativity Problems.

Sidelights on Relativity. By Prof. A. Einstein. I. Ether and Relativity. II. Geometry and Experience. Translated by Dr. G. B. Jeffery and Dr. W. Perrett. Pp. iv+56. (London: Methuen and Co., Ltd., 1922). 3*s*. 6*d*. net.

PARTICULARLY since the introduction of the theory of relativity, the problem of the ether has been a bone of contention among physicists. They have been divided into two camps; one unwilling to let go the idea of an ether, though perhaps in modified form, and the other seeing in the theory of relativity, if not the negation of an ether, at least something that rendered it no longer necessary. In view of this, it is to be welcomed that Prof. Einstein's inaugural lecture on "Ether and the Theory of Relativity," which was delivered in 1920 at the University of Leyden, has been made accessible to the English scientific public.

"The endeavour toward a unified view of the nature of forces leads to the hypothesis of an ether," and in the first lecture in this book is to be found an excellent account of the various phases through which the ether-conception passed in the forward trend of physical research. The ether gradually became divested of its mechanical properties until, with the advent of the special theory of relativity, it was deprived of the "last mechanical characteristic which Lorentz had still left it"—its "immobility." But "to deny the ether is ultimately to assume that empty space has no physical qualities whatever," a view with which the fundamental facts of mechanics do not harmonise.

"According to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether. According to the general theory of relativity space without ether is unthinkable; for in such space there would not only be no propagation of light, but also no possibility of existence for standards of space and time (measuring-rods and clocks), nor therefore any space-time intervals in the physical sense. But this ether may not be thought of as endowed with the quality characteristic of ponderable media, as consisting of parts which may be tracked through time. The idea of motion may not be applied to it."

The second lecture, on "Geometry and Experience," is an expanded form of an address delivered in 1921 to the Prussian Academy of Science in Berlin. In geometry, "axioms are free creations of the human mind. All other propositions of geometry are logical inferences from the axioms," and "the matter of which geometry treats is first defined by the axioms," or what Schlick aptly calls "implicit definitions." But geometry first becomes a natural science "by the co-ordination of real objects of experience with the empty conceptual framework of axiomatic geometry." "Geometry predicates nothing about the relations of real things, but only geometry together with the purport of physical laws can do so." The question as to the nature of the structure of a continuum is a physical one to which experience must supply the answer, and we must acknowledge Riemann's geometry to be correct "if the laws of disposition of practically rigid bodies are transformable into those of the bodies of Euclidean geometry with an exactitude which increases in proportion as the dimensions of the part of space-time under consideration are diminished."

The question of the spatial finiteness or otherwise of the universe appears to be definitely a "pregnant question in the sense of practical geometry." Einstein discusses this problem in its various aspects from the view-point of the results of the general theory of relativity, and shows how, by the use of an analogy in two dimensions, we may form a mental picture of a three-dimensional universe which is finite, yet unbounded, and not Euclidean, but spherical. He aims at showing "that the human faculty of visualisation is by no means bound to capitulate to non-Euclidean geometry."

To all lovers of logical and exact thought who are interested in the developments that have arisen in the wake of the theory of relativity, this book can be warmly recommended. The work of translation has been admirably done, and much of the *finesse* of expression characteristic of Einstein's writings has been retained.

Geographical Influences.

The Great Capitals: an Historical Geography. By Dr. Vaughan Cornish. Pp. xii+296. (London: Methuen and Co., Ltd., 1923.) 12*s.* 6*d.* net.

IT may be said at once that we regard this as one of the most important and original works in geography that have appeared within a generation. The volume should be looked upon by teachers of geography as essential to their studies. It cannot be denied that the book is not easy reading; it must have cost an immense amount of pains to write. The result is, however, worth the pains, and though readers who will follow every page with the aid of a good atlas may indeed find that they make but slow progress, they will be well rewarded for their labour and lose all desire to hurry through the interest roused by tracing the author's line of thought. There are no doubt many who, with the best will in the world, cannot find the necessary time to complete the study of the whole work. We would advise these first, if they must read the volume piecemeal, to keep it always at hand, and, second, at least to find the time to master the author's account, say, of the situation of Moscow (pp. 181-91) or London (pp. 211 and onwards). If one of these has been read with the necessary care, the reader, if he has been hitherto unfamiliar with the geographical point of view, can scarcely fail thenceforth to understand what geography means, and even professed geographers will be warned against one danger now rather prevalent arising from a too narrow study of "natural regions." Dr. Cornish never fails to take into account the wide-reaching influences on the rise and growth of towns.

The author's views on the special subject of his volume are set forth in his preface as follows:

"An historical examination of imperial capitals shows that their district is usually either a Storehouse, or a far-reaching Crossways near a Storehouse, seldom a Stronghold. Their political geography has one outstanding character, a forward, as distinguished from a central, site. The Great Power both of ancient and modern times has always been an incorporation of several States, and the characteristic site of the imperial capital is in or adjacent to that Storehouse of the dominant community of the empire which is nearest to the principal foreign neighbour."

This position the author endeavours to make good by ranging over all recorded time and the greater part of the world, examining his thesis in the light of the earlier and later history and geography of China, Japan, India, Persia, Mesopotamia, Italy and the Roman Empire of the West and East, Trans-Alpine Europe, North and South America, taking every opportunity presenting itself in the course of his investigation to show the infinite variety of ways in which geographical factors affect history and the course of events brings about changes in geographical values. On the whole, he may be said to have made out his case, and at any rate he has always something ingenious and interesting to say in support of it, not least when he is applying his theory to certain minor illustrations, as in dealing with the capitals of the "heptarchy" or the Iroquois capitals in the neighbourhood of the great lakes of North America. But he is not dogmatic. He will sometimes qualify his averments by an "I think" or "I suppose," and the very fulness with which he brings forward his arguments is an invitation to the student to judge before accepting, in Bacon's language "to weigh and consider."

If here and there are found some rather broad and questionable historical statements, the student should note that the validity of the geographical exposition is not necessarily affected thereby. The present reviewer lays no claim to any intimate knowledge of Indian history, but was rather startled on meeting with the statement (p. 28) that "twice in the course of history has a government seated and independent of foreign control, ruled the whole, or nearly the whole, peninsula," and he cannot find that it is fairly justified; but that does not affect the value of the author's geographical considerations as to Patna, the capital of "the Aryan Empire," or Delhi, that of "the Empire of the Mohammedan Moghuls."

The volume is illustrated by two maps, one showing "The Isothermal Frontier of Ancient Cities," the other "The Marmora Metropolitan Region." A few more maps of the latter kind would have assisted the student greatly.

GEO. G. CHISHOLM.

Our Bookshelf.

Atoms. By T. C. Wignall and G. D. Knox. Pp. 288. (London: Mills and Boon, Ltd., 1923.) 7*s.* 6*d.* net.

White Lightning. By Edwin Herbert Lewis. Pp. iv+354. (Chicago: Covici-McGee, 1923.) n.p.

THESE two scientific novels both centre around the idea of liberating the energy of the atom—a theme first explored by Mr. H. G. Wells in "The World Set Free." They may be taken as indicative of the interest being taken by the public in the recent developments of physical science.

The first, "Atoms," a highly imaginative romance, reflects strongly some of the most cherished popular conceptions or misconceptions about the growth of science. Super-financiers contend with one another and with or through the regular international anarchist associations in an atmosphere of dynamite plots, assassinations, and impersonations, in order to corner the world's supplies of energy. A colossal plant for producing power from coal and distributing it by wireless springs up at the word of command, and is converted during erection into an atomic energy plant by the discovery of *sublimium*. Sublimium dis-

integrates everything it comes into contact with except *refracton*, and it is conveyed in capillary tubes of the latter, a metre thick in the wall, in minute quantities from the laboratory to the furnaces. The authors are clever enough to get the best out of both possible worlds, and succeed, not only in showing us the effects of Paris being converted into an inferno through anarchists blowing up the refracton tubes, but also at the same time to bring the venture to a brilliantly successful conclusion with the hero and heroine happily off for the honeymoon.

"White Lightning" is a most curious production. Each of its ninety-two chapters is named after one of the elements in the order of the Periodic Table, and, in most of the chapters, the author succeeds in bringing in some interesting allusion to modern discoveries in chemistry and physics, if not always specially connected with the titular deity of the chapter. The style is irritatingly disconnected and inconsequent, but it manages to convey some idea of the fascination and glamour of discovery and the enthusiasms of which it is born. Emanating from America, it is no surprise to find that this author's *dénouement* is to endow, through the generosity of his public-spirited characters, the hero and the heroine with a research laboratory to be devoted to the study of the liberation of atomic energy. F. S.

The Great Flint Implements of Cromer, Norfolk. By J. Reid Moir. (Printed and published on behalf of the author for private circulation.) Pp. 39. (Ipswich: W. E. Harrison, 1923.)

THE title of this book is scarcely adequate, for the work treats of many periods, from that of the "eoliths" to neolithic times. Many of Mr. Moir's views were at first regarded with profound scepticism, but are being accepted by an ever-increasing number of competent judges at home and abroad. In the work before us they are briefly summarised, but the account is too condensed to do justice to the author's discoveries. We hope that in the not distant future he will write a detailed work on the pre-history of East Anglia, and that it will be illustrated by Mr. E. T. Lingwood, the excellence of whose illustrations in the work before us is noteworthy.

Three important questions arise with regard to the Cromer flints here described: (1) Are they derived from Pliocene beds? (2) Are they artefacts? (3) If they are, to which cultural period do they belong? The evidence bearing upon the first two questions is only summarised in the work before us, though more fully stated in papers to which reference is made. After reading that evidence, and after a visit to the spot under the author's guidance, the reviewer is of opinion that Mr. Moir is correct in his contention that the flints were once embedded in a Pliocene pebble-deposit, and that many of them are undoubted artefacts. Stress is laid upon the last point, as the specimens figured here will probably be regarded with suspicion by sceptics, and many others which are not figured are more convincing.

The reference to the early Chellean period is regarded only as a probability by the author, but perusal of this and other of his writings leads one to consider that he has made out a good case in favour of this probability.

The Happy Traveller: a Book for Poor Men. By the Rev. Frank Tatchell. Pp. xii+271. (London: Methuen and Co., Ltd., 1923.) 7*s.* 6*d.* net.

THE author of this distinctly original book is a Sussex vicar, and we can picture him setting out for Hierusalem from the Middeherst of the twelfth century, in robust amity with all whom he might meet upon the way. Once outside the door of home (p. vii), he is never conscious of an obstacle. Like the young Jesuit Thomas Stevens, whose letter is preserved by Hakluyt, he is going to see his first shark, his first flying-fish (p. 140), and to learn, by personal encounter, the essential glory of the earth. Even between the poplars of a *route nationale* Mr. Tatchell goes on foot. He is forced to embark on liners for the greater seas; but he has travelled as a steerage passenger and as a steward, and we learn that "the 'deck' passages on Japanese boats are especially good."

The lists of common phrases in foreign languages might well have been omitted. We cannot judge the Burmese and the six words of Papuan, and they may be "happier" than the French. Yet we should be sorry to lose the conversation between the vicar-designate and the Fijian damsel on pp. 225-6. The notes on local customs are always helpful, and are backed by a truly catholic philosophy. Touches like the following add a sparkle to the printed page. "If you want to preserve your illusions, do not visit Palestine" (p. iv). "Should you be attacked by a mob in the East, hurt one of the crowd and hurt him quickly" (p. 23). "If you are in the steerage, take also some fruit and jam and a bottle of rum, which nowhere tastes so well as at sea" (p. 139). R. L. Stevenson would have enjoyed this passage, and he would have endorsed the maxim on p. 7: "The beaten track is the best track, but devote most of your time to the by-ways." G. A. J. C.

The Coconut Palm: the Science and Practice of Coconut Cultivation. By H. C. Sampson. Pp. xv+262+40 plates. (London: J. Bale, Sons, and Danielsson, Ltd., 1923.) 31*s.* 6*d.* net.

THIS book is a welcome departure from the usual type of manual that deals in generalities about the plant concerned, with a fuller account of the methods of cultivation. Its author is to be congratulated upon having broken new ground, and it is by such study as is described in this volume that we may hope to arrive in time at a really scientific method of cultivating and treating the palm. Detailed scientific observations are given, for example, upon the numbers, the direction of growth, and the behaviour of the roots, a subject upon which we have usually had only vague generalities to go upon. Many other subjects are treated in the same way, *e.g.* the flowering, the relative proportions of flowers that set fruit, and so on.

The second part of the book deals with plantation management, and gives a very good, clear, and well-reasoned account of the methods in use, and the reasons for them—an account which will repay study even by the experienced coconut planter. In Part III. the products of the coconut palm are dealt with, and the methods of preparation employed in South India, the coconut products of which command the highest

prices, are considered and discussed, and the reasons for the treatment are pointed out.

The book is the best that we have seen treating of the coconut palm, and should be in the hands of every one interested in the industry.

Department of Applied Statistics (Computing Section), University of London, University College. Tracts for Computers. (1) No. 4: *Tables of the Logarithms of the Complete* Γ*-Function to Twelve Figures.* Originally computed by A. M. Legendre. Pp. iv+10. 1921. (2) No. 8: *Table of the Logarithms of the Complete* Γ*-Function (for Arguments 2 to 1200, i.e. beyond Legendre's Range.)* By Egon S. Pearson. Pp. x+16. 1922. (3) No. 9: *Log* Γ(*x*) *from* $x=1$ *to* 50·9 *by intervals of* ·01. By Dr. John Brownlee. Pp. 23. 1923. (London: Cambridge University Press, 1923.) 3*s.* 9*d.* net each.

(1) THIS tract gives a reprint of Legendre's table originally published in the (now rare) second volume of his "Traité des fonctions elliptiques" (1825). It records the numerical value of $\log_{10}\Gamma(p)$ from 1·000 to 2·000, at intervals of 0·001, to twelve places of decimals, together with the first, second, and third differences for interpolation.

(2) In the second tract before us we have $\log_{10}\Gamma(p)$, correct to ten decimal places, for values of p at intervals of 0·1 from 2·0 to 5·0, of 0·2 from 5·0 to 70·0, and of a unit from 70 to 1200. Second and fourth differences are tabulated also, giving all necessary assistance in evaluating the function for intermediate values of p. From the last entry it can be inferred that Γ(1200), or 1199 !, is an integer of 3173 digits.

(3) Finally we have $\log_{10}\Gamma(p)$ tabulated to seven decimals at intervals of 0·01 from 1·0 to 50·9. This pamphlet rounds off the work on the Γ-function in the present series of tracts.

The Diseases of the Tea Bush. By T. Petch. Pp. xii+220. (London: Macmillan and Co., Ltd., 1923.) 20*s.* net.

THIRTY years ago planters were inclined, when an outbreak of disease occurred among their crops, to conceal it from general knowledge or observation as much as possible, the result being that little or nothing was known, from a scientific point of view, of the diseases attacking tea. As time has gone on, however, this has altered. Watt and Mann, in 1903, described about a dozen diseases, and in the present volume the number has increased to about sixty. Whether more harm is now being done by disease, however, is very doubtful; on the whole it is perhaps less.

The book is prefaced by one of the simplest and best introductions to the study of fungi that we have yet seen. The diseases are treated in order, according to whether they attack leaves only, leaf and stem, stem, or root; and for each disease the characteristic manifestations are described, with excellent figures of the most important, while at the end of the book instructions are given for the preparation of Bordeaux and other fungicidal mixtures for spraying—a treatment which has come into considerable use during recent years, and leaves but an infinitesimal trace of copper in the tea.

Bau und Entstehung der Alpen. Von Prof. Dr. L. Kober. Pp. iv+283+8 Tafeln. (Berlin: Gebrüder Borntraeger, 1923.) 12*s.*

Two years ago attention was directed to Prof. L. Kober's view that folded mountain-chains are marginal features of a geosynclinal "orogen" nipped between two mutually approaching masses of "kratogen" in the depths (NATURE, vol. 108, October 20, 1921, p. 236). The present work embodies a lucid review of the researches of the last forty years in the Alpine region, which is intimately known to the author from the Pennines to the Transylvanian wall. Through all details, however, he maintains his outlook on the world at large. In neat diagrams he shows how a dual structure is traceable in the western United States, in the Caledonian orogen of Scotland and Scandinavia, and in the axis of Japan. The floor of the Tēthys channel (Fig. 2) has been squeezed up here and there to form mountain bulges from Andalusia to Sumatra, over a distance of 14,000 km. In the Alpine region only, a one-sided character has been imparted to the mountain-mass, and this is due to the fact that the southern marginal range, the Dunaric, has been moved northward until part of it overlies the east Alpine sheet. In agreement with H. Roothaan (1918), Prof. Kober (p. 252) places the beginning of Alpine overfolding in Cretaceous times, and the main movements in the Oligocene period. To quote the final words of this stimulating volume, "noch manche Rätsel bergen die Alpen." G. A. J. C.

Colour Index. Edited by Dr. F. M. Rowe. Part 1. Pp. viii+48. (Bradford: Society of Dyers and Colourists, n.d.) n.p.

THIS is the first part of a work that is being published, in fourteen monthly parts, by the Society of Dyers and Colourists, Bradford, with the object of making available, in the English language, to dye users and all interested in colouring matters, the latest information concerning commercial dyes, their constitution, modes of preparation, and uses.

Part 1 deals with the nitroso, the nitro, and a portion of the azo colours, while it is understood that when the work is completed it will contain descriptions of some 1300 distinct synthetic colouring matters.

The information is set out in tabular form, closely resembling that used in the well-known "Farbstofftabellen" of Schultz, but with the welcome addition of ample space for notes, and brought up-to-date by the inclusion of much information that is lacking in the "Farbstofftabellen."

It is well produced, and is a work that should be in the hands of all who are interested in colouring matters, whether from a scientific or practical point of view.

The Birth of Psyche. By L. Charles-Baudouin. Translated by F. Rothwell. Pp. xxiii+211. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., 1923.) 5*s.* net.

A SELECTION of short memories of childhood written as prose poems with a distinct consciousness of scientific value in their significance. The author has written a preface to the English translation, in which he defends the presentation of scientific material in poetical form.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Photochemical Production of Formaldehyde.

In a recent paper (J. Amer. Chem. Soc., 45, 1184 (1923)) Spoehr states that he has been entirely unable to reproduce our results on the photochemical production of formaldehyde from carbon dioxide and water (Trans. Chem. Soc., 119, 1025 (1921)), and he invites us to describe our experimental methods in greater detail than we did in our original communication. Before replying to this invitation we have repeated all our experiments and the new results entirely confirm the old, and there seems, therefore, to be little or no doubt that by the action of short wave ultra-violet light on aqueous solutions of carbonic acid formaldehyde is formed.

The quartz mercury lamps employed in all our investigations are the U form made by the Hewittic Company and the current taken by each lamp is 3·5 amps. at 230 volts. About 75 c.c. of pure conductivity water were placed in a transparent quartz test tube 9 × 1 in., and a slow stream of carbon dioxide, prepared from pure marble and synthetic hydrochloric acid and washed with a solution of potassium bicarbonate, was passed through the water. The carbonic acid solution was kept cool by a narrow tube through which a stream of cold water was passed. Stringent precautions were taken to guard against contamination by organic matter, and the times of exposure varied from 18 to 72 hours. Since the most satisfactory test for formaldehyde appears to be Schryver's test we have used it in every case, and throughout the whole series of observations we carried out control blank experiments. The results obtained may be summarised as follows :—

1. No formaldehyde can be detected in the solutions if the distance between the lamp and test tubes is less than six inches and no screen is interposed.

2. Formaldehyde can be detected in the solutions if the distance between the lamp and test tubes is six inches or more.

3. The quantity of formaldehyde formed is increased if a plate of calcite is interposed, and in this case the distance between the lamp and test tubes can be reduced with advantage.

4. The quantity of formaldehyde found is increased if the solution contains calcium or potassium bicarbonate.

The amount of formaldehyde found, though absolutely definite, is very small (1 to 2 parts in 100,000), the reason for this being twofold. The absorption band of carbonic acid lies near to $\lambda = 220\mu\mu$ and the intensity of the radiation of the mercury lamp at or about this wave-length is exceedingly small, so that the velocity of formation of formaldehyde must necessarily be very slow, even assuming that the whole of the radiation is absorbed. A second factor is that formaldehyde in dilute aqueous solution is decomposed by very short wave-length light. Indeed, a 0·01 per cent. solution of formaldehyde through which carbon dioxide is passed is entirely decomposed in 24 hours if placed at a distance of 4 inches from the quartz mercury lamp. It follows, therefore, that the formaldehyde found in the solutions described above is only the excess of that formed over that decomposed. The very short wave-length radiations are more absorbed by air than is light of wave-length $220\mu\mu$, and thus an explanation is found of the fact that a minimum distance between reaction vessel and quartz lamp is necessary for positive evidence to be obtained of the production of formaldehyde. Since calcite absorbs all rays of shorter wave-length than $215\mu\mu$, the amount of formaldehyde is increased if a calcite screen is interposed and the minimum distance between lamp and test tube becomes no longer necessary.

In view of our two series of positive results it is surprising that Spoehr finds himself unable to confirm this reaction, since the evidence we have obtained seems to us to be conclusive. In his paper Spoehr states that he used the straight form of mercury lamp, and in this may be found a possible explanation of the failure which he has recorded. It is a known fact that the quartz mercury lamp deteriorates after use and loses its power of radiating short wave ultra-violet light. Prof. Allmand has proved this deterioration of a mercury lamp of the straight form and has been kind enough to communicate his results to us. It may be suggested that this fact explains Spoehr's failure to observe any formaldehyde, the necessary ultra-violet radiation from his lamps being too small in amount. We have noted that the U-shaped lamp does not deteriorate, or, if so, very slowly, since our lamps after many months' continuous use still ozonise the oxygen of the surrounding air, a photochemical reaction which is known to be stimulated by very short wave-length light ($\lambda = 200\mu\mu$).

The great dilution of the formaldehyde necessitates the use of a colorimetric test for its detection. In view of Willstätter's statement that the Schryver test is given only by formaldehyde and hexylenic aldehyde, this reaction has commonly been accepted as positive evidence for formaldehyde. We have, therefore, employed this test, having at the same time proved for our own satisfaction that it certainly is capable of detecting formaldehyde at concentrations of 1 in 1,000,000.

E. C. C. Baly.
I. M. Heilbron.
W. F. Barker.

Correlation of Upper Air Variables.

In view of the importance of the subject, a few remarks with regard to the note in Nature of May 19, p. 684, on "Correlation of Upper Air Variables" may perhaps be permitted me, chiefly with the object of making clear the real issues in this question. Dines [1] found very high coefficients of correlation (of the order of 0·8) between various upper air variables, specially with pressure at 9-kilometre level. This led to the formulation of the Dines-Shaw theory of the sub-stratosphere and the regions above 9 kilometres as the real seat of origin of meteorological causes. In 1920, Chapman [2] applied certain statistical corrections to the coefficients of correlation found by Dines and raised these to +1·00 in several instances. A correlation of +1·00 establishes absolute causal nexus. A conclusion of this nature demands close scrutiny, specially as it is being widely quoted and applied in current writings.[3] In a recent memoir [4] noticed in Nature [5] I have examined the statistical analysis in some detail.

As regards Chapman's work, my chief criticism is this: he has neglected entirely the effect of correlation between "errors" of measurement. Taking

[1] M.O. No. 210*b*, Geophys. Mem. 2, 1912; M.O. No. 220*c*, Geophys. Mem. 13, 1919, etc.
[2] Proc. Roy. Soc. 98 A (1920), pp. 235-248.
[3] M.O. No. 220*i*, Geophys. Mem. 19, p. 215; Sir Napier Shaw, "The Birth and Death of Cyclones."
[4] Mem. Ind. Met. Dept., vol. xxiv. Part ii., "On Errors of Observation and Upper Air Relationships."
[5] Nature, May 19, 1923, p. 684.

these into consideration, my analysis shows that: (A) the statistical correction may easily become negative; that is, the true correlation may be considerably lower than the observed correlation. On the other hand, if "errors" are independent (or as my analysis shows, for particular values of correlation between errors), then (B) the correlation may be positive as found by Chapman, and the true correlation higher than the observed. The question is: under which category (A) or (B) above does the work of Dines fall?

In the case of a balloon meteograph, all measurements are made on one and the same trace,[6] and the heights are calculated with the help of Laplace's formula.[7] This formula involves both pressure and temperature, and a detailed examination shows that it serves to introduce, through "interpolation," correlation between errors of measurement in pressure and temperature. Besides this "interpolation" effect, correlation may also be introduced through what Karl Pearson[8] calls the "atmosphere" of measurement and through correlation of successive judgments.[9] It is, therefore, not improbable that Dines's work falls under (A) and gives values of correlation coefficients higher than their true values. My contention is this: (C) in the absence of definite proof that Dines's work falls under (B), Chapman's corrections cannot be accepted as real, and, to be on the safe side, Dines's coefficients must be looked upon as giving superior limits to the true correlation.

Douglas[10] found the values of correlation between pressure and temperature at 10,000 feet to be 0·65, which is considerably lower than Dines's figure 0·77 (and still more so than Chapman's corrected value). I quoted Douglas's result, as I thought his work to be free from the peculiar "interpolation" correlation introduced by the use of Laplace's formula. On this view, Douglas's work would probably come under (B) and would give values of correlation lower than true values. I now find stated in the note in NATURE that I have fallen into error in thinking "that Douglas's coefficients are based on true heights." (The fault, however, is scarcely mine, for Douglas himself definitely stated[11] that his observations "refer to actual heights above mean sea-level, and not to aneroid heights.") On the present view, Douglas's work also would probably come under (A) above, and even 0·65 would seem to be too high a value for the true correlation. This corroborates my contention (C) that Dines's coefficients are probably too high. It is, therefore, clear that the rectification of my error has further strengthened my conclusion. I may note in passing that the low values of the coefficients obtained by Douglas may be easily explained in accordance with my analysis if we assume that the magnitude of the correlations between errors of measurement are lower in his case.

In my other memoir[12] I pointed out certain statistical discrepancies in the coefficients published by Dines. It is stated in the note in NATURE that I seem "to have confused the T_m used by Dines, namely, the mean temperature between 1 and 9 kilometres, with the mean temperature between 0 and 9 kilometres," and that this supposed confusion on my part "fully explains the discrepancies" noted by me. I am unable to agree with this, as I do not think I have made any confusion between the two mean temperatures referred to above. On p. 1 and p. 3 of my memoir I have explained clearly that T_z represents the mean temperature between 0 and Z kilometres, and I have kept T_z and T_m distinct throughout. It is true I have substituted $dT_z = dT_m$, but this is quite different from putting $T_z = T_m$, since dT_z and dT_m are both statistical differences (which would ultimately be summed and averaged out) and not analytic differentials. This substitution is further discussed on p. 6 of my memoir. Now if this substitution is justified, then it follows from Laplace's equation that: (D) in the case of the figures published by Dines it is actually possible to obtain higher values of the correlation coefficients at levels considerably lower than 9 kilometres. In view of the assumption involved it is, however, necessary to test (D) by direct examination of the data concerned. But in the absence of such examination it is not sufficient to state that "discrepancies can be explained."

To sum up, the main problem is to find (*a*) the true correlation, and (*b*) the region of the best correlation in the case of upper air variables. It would seem that in view of (A), (C), and (D) above, the work of Dines and Chapman (which is flatly contradicted by that of Douglas) cannot be accepted as final either as regards (*a*) or as regards (*b*). Further advance is not possible without a thorough statistical scrutiny of the original data.

May I, therefore, suggest that (i.) the original material of Dines and Douglas (as well as other fresh material, if available) be published with clear statements about methods of measurement employed and actual formulæ (rigid or otherwise) used for computation of heights, and that (ii.) such material be submitted to some statistical expert like Prof. Karl Pearson for examination and report.

P. C. MAHALANOBIS.

Presidency College, Calcutta,
June 20.

THE results of the British Registering Balloon Ascents are published in full by the Meteorological Office in the Annual Supplement to the *Geophysical Journal*. A full description of the instruments, methods, and formulæ used have also been published by the M.O., and will be found in the "Computer's Handbook," M.O. 223, Section II., subsection ii. They are open to anybody for use, and if Prof. Mahalanobis will carry out the computation he desires he will earn the thanks of meteorologists.

It is difficult, however, to see how Prof. Mahalanobis can obtain a perfectly correct correlation coefficient, in view of the fact that, with a coefficient of 0·70 based on 400 observations, the causal standard error is as high as 0·025. This fact suffices to explain the differences between Dines's and Douglas's results, which can scarcely be called a "flat contradiction."

With reference to Prof. Mahalanobis' assumption, that $dT_z = dT_m$, it may be pointed out that the result of making this assumption is discussed in the papers to which he referred, and also that no claim to extreme accuracy in the correlation coefficient is made by Dines. (See M.O. 210*b*, bottom of p. 43, and p. 44, line 11; also *Beiträge zur Physik der freien Atmosphäre*, V. Band, Heft 4, pp. 222, 223, and 225.) THE WRITER OF THE NOTE.

Tubular Cavities in Sarsens.

WITH regard to Mr. F. Chapman's letter on the probable æolian origin of sarsen rock (NATURE, August 18, p. 239), and his reference therein to my previous note, may I say that I was not referring to

[6] M.O. No. 210*f*, Geophys. Mem. 6, 1914.
[7] M.O. No. 223, "Computer's Handbook," Section 2.
[8] Phil. Trans. 198 A, 1902, "Errors of Judgment," etc.
[9] Egon S. Pearson, *Biometrika*, xiv., 1922.
[10] Quar. Jour. Met. Soc., xlvii., January 1921, p. 28, etc.
[11] *Ibid.* p. 25.
[12] Mem. Ind. Met. Dept., vol. xxiv. Part I., "The Seat of Activity in the Upper Air."

the holes so frequently present in the blocks—which I was told, when a student at the Royal School of Mines, some forty years ago, might be due to the presence of roots and rootlets in the sand before consolidation—but to a special case in which all the details *suggested*, from my previous knowledge of such things, the work of marine or esturine annelids. Without having seen what I saw, Mr. Chapman questions the validity of the grounds for the suggestion.

There is no evidence that the blocks to which I referred originated in the Bagshot Sands. They may have been associated with the Reading beds.

Assuming that all the tubular cavities in sarsens were caused through the presence of roots and rootlets in the original sand, what evidence is there that such roots grew *in situ*? It may have been driftwood. Plenty of such wood is to be found, in a lignitic and pyritised condition, in some of the Bagshot beds. I have seen some sarsen rock passing into conglomerate, indicating the proximity of littoral conditions.

It would be of interest to know if Mr. Chapman has found any grains of comminuted land shells, burrows and bones of animals, and burrows and remains of insects in the consolidated dune-rock he describes.

C. CARUS-WILSON.

Strawberry Hill, Middlesex,
August 18.

Barometric Pressure in High Latitudes.

MR. R. M. DEELEY'S reply in NATURE of August 18 to my letter in the issue of June 21 does not meet my objection, and since he repeats the misleading statement that surface pressure is low at the poles it seems desirable to come to a closer definition of terms. In my letter I made it clear that surface pressure was to be regarded "high" at the poles, not so much in relation to the absolute value as with respect to the belt of minimum pressure—the theatre of maximum cyclonic activity—about latitude 60° N. or S.; but Mr. Deeley under the general term "Arctic regions" does not distinguish between the sub-polar regions about 60° N. or S. and the true polar regions about 90° N. or S.

In maps produced by the late Prof. H. Mohn in his masterly discussion of the scientific results of the *Fram* expedition of 1893–96, which confirm in a remarkable way previous work of the late Dr. A. Buchan (see, for example, "Encycl. Britannica," 1911 edn., Polar Regions), it is shown that in winter a ridge of high pressure (over 762 mm.) is located across the North Polar basin connecting the great Canadian and Siberian high pressure areas, and separating the deep barometric minima of Bering Sea and Iceland (748 mm.), and that this is the season when the pressure gradient is steepest on the north side of these minima, just as it is on the south side. Dr. G. C. Simpson's maps embodied in his famous Antarctic volume are no less emphatic about relatively high surface pressure around the South Pole, even on that part of the area which is high plateau, and the fact that the expression "Antarctic Anticyclone" is nowadays a household word among meteorologists, geographers, and geologists alike ought to prevent unqualified statements to the effect that the South Pole is a centre of low surface pressure. It has been found that towards both poles pressure decreases from lat. 40° N. or S. at the height of about 6000 feet, but at the surface the total effect of all layers is to produce that slight excess of pressure which permits the polar outflow of air which Mr. Deeley admits does take place.

Mr. Deeley then goes on to say that he has attempted to explain why these outflowing polar winds do not reach low latitudes. But any one who thinks in terms of daily weather changes instead of in the cast-iron terms of average wind and pressure charts must realise that polar currents *do* have abundant opportunity of reaching low latitudes at irregular intervals, this, furthermore, being a foremost point in the theory of Prof. Bjerknes. There is nothing which so paralyses meteorological thought as the habit of regarding mean charts as though they represented actual unchanging conditions rather than merely the generalised expression of conditions which are perpetually varying to such an extent that the average type depicted is comparatively seldom realised, is generally to a greater or lesser extent distorted, and occasionally altogether subverted or inverted, as during our spells of east wind in the belt of "westerlies."

Finally, whatever effect the stratosphere may have on pressure at sea-level, Mr. Deeley appears to forget that the broad facts of low winter pressure over the oceans and high continental pressure are mutually complementary, as also the reverse distribution of high summer oceanic pressure and low continental pressure, and are well known to be due to seasonal contrasts of surface temperature, the difference of both pressure and temperature being greater in winter.

L. C. W. BONACINA.

27 Tanza Road, Hampstead, N.W.3,
August 19.

Is there a Change of Wave-length on Reflection of X-rays from Crystals?

A. H. COMPTON (*Phys. Rev.*, 21, 207) has recently shown that there is a change of wave-length when X-rays are scattered by an amorphous substance. If reflection of X-rays from crystals is a special case of scattering it would seem that there might be also a change of wave-length on reflection. Assuming such a wave-length change, we have for reflection from a single plane of atoms

$$(1) \quad \frac{\cos\theta_1}{\lambda_1}=\frac{\cos\theta_2}{\lambda_2},$$

where λ_1 and λ_2 are the incident and reflected wave-lengths and θ_1 and θ_2 are the grazing angles of incidence and reflection respectively. For reflection from successive planes of atoms we have

$$(2) \quad \frac{d\sin\theta_1}{\lambda_1}+\frac{d\sin\theta_2}{\lambda_2}=n,$$

where d is the grating space of the crystal and n is the number of vibrations (an integer) difference between the waves reflected from two consecutive planes. Also we have Compton's change of wave-length formula

$$(3) \quad \lambda_2=\lambda_1+2\gamma\sin^2(\theta_1+\theta_2)/2,$$

where $\gamma=h/mc=0{\cdot}024$ Å.U.

From these three relations the formula for the incident wave-length λ_1 can be found in terms of d and θ_1, which is the angle measured experimentally. Let λ' be the apparent wave-length obtained from Bragg's law $n\lambda'=2d\sin\theta_1$. The relation between λ' and λ_1 is found to be

$$(4) \quad \lambda'=\lambda_1+\gamma-\frac{\gamma^2\sin^2\theta_1}{\lambda_1+\gamma}.$$

From this it appears that λ' is greater than λ_1, the true wave-length, by about 0·024 Å.U. Also it appears that λ' is less for higher orders of reflection, a result

which has been observed experimentally by Stenström and also by Duane and Patterson (*Phys. Rev.*, 16, 532). The latter find that the difference between the values of λ' when the tungsten line 1·473 Å.U. is reflected in the first and second orders from calcite is 0·00015±0·00009 Å.U. Formula (4) gives a difference of 0·00007 Å.U., which is within experimental error of the observed difference. However, this difference may also be explained on the assumption of a refractive index for X-rays.

X-ray wave-lengths are also measured by observing the angle of deviation $(\theta_1+\theta_2)$ between the reflected and incident ray. This is particularly the case when the photographic method is used (Siegbahn, Dershem, Overn and others). Let λ'' be the apparent wave-length when $\theta_1+\theta_2$ is observed so that $n\lambda''=2d\sin(\theta_1+\theta_2)/2$. We now have a difference between λ' and λ'' on our theory given by

$$(5) \quad \lambda'-\lambda''=\gamma\cos^2\theta_1$$

to the first power of γ. For the lower orders of reflection this difference is approximately 0·024 Å.U., which should be easily observable. Overn (*Phys. Rev.*, 14, 137) has found λ'' for the above line. Comparing with Duane and Patterson's value of λ' for the same line we find the experimental value of $\lambda'-\lambda''$ to be 0·0005 Å.U., which is within experimental error of zero. This would seem to be decisive evidence that there is no change of wave-length when X-rays are reflected from a crystal.

G. E. M. JAUNCEY.
CARL H. ECKART.
Physics Laboratory, Washington University,
St. Louis, Mo., U.S.A., July 3.

On the Structure of the Molecule.

THE difficulty of reconciling the atomic systems of Bohr and of Langmuir, and of accounting for the attraction between atoms to form molecules and chemical compounds, might perhaps be elucidated in the following way.

If the analogy between atomic structure and astronomical planetary systems holds good, the atom is essentially a two-dimensional figure, while matter, which is composed of atoms, is essentially three-dimensional.

If then combination takes place between two or more atoms, it would be reasonable to suppose that

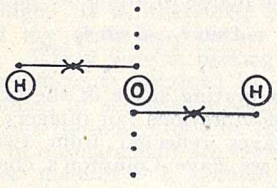

FIG. 1.

this does not take place in the same plane as the electronic orbit—an idea which is borne out by the work of Bragg on crystal structure.

We may suppose combination to take place somewhat as follows, in the formation of H_2O :—

If the plane of electrons be represented in Fig. 1 by the dots, it would be quite possible, if an electron were to be drawn out of the normal plane of each atom as indicated by the arrows, for it to form part of two atoms while revolving in a similar orbit to the original one but, owing to its divided allegiance, in a different plane. It would seem, however, that it would very soon take up a position directly between the two nuclei, when it would become *static*.

In the case of hydrogen, which has only a sufficient positive charge in the nucleus to hold one negative electron, if we suppose two electrons to be drawn out of the plane—one from each atom—the projection from the oxygen atom would be negative in sign, forming a negative link between two positive nuclei. This would perhaps explain the quite unique position of hydrogen in chemical combinations.

The system could be applied quite readily to more complex molecules. Bragg's model of the tartaric acid molecule (see NATURE of June 9, Supplement, p. ix) is readily amenable to this way of treatment,

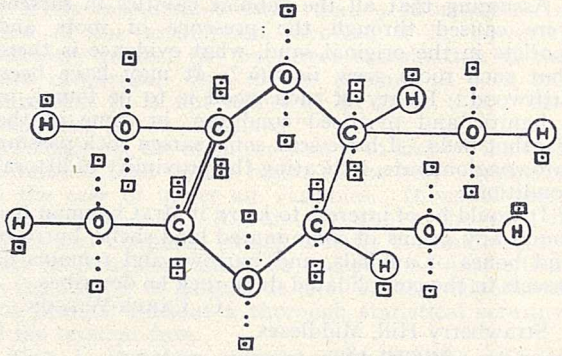

FIG. 2.

as the accompanying diagram (Fig. 2) will show, the electrons coming out of their respective systems being shown surrounded by a square.

It will be seen too from Sir W. Bragg's drawings that the links may easily be conceived as being in planes which would not interfere with the orbital motions of the remaining electrons.

The suggestion is then that, in the formation of the molecule, both dynamic and static electrons have their place, and this will throw considerable light on the nature of the links between the two or more positive nuclei.

A. PEARSE JENKIN.
Trewirgie, Redruth, July 20.

A Primitive Lens.

IF a wire of ½ to ¾ mm. diameter be bent into a closed circular loop of about 8 mm. diameter and dipped in water, or a transparent oil such as castor oil, a stable liquid film can be readily obtained covering the loop. A thin dished metal disc with a circular hole in the centre is a convenient alternative to the wire loop. Liquid can be easily added or removed without breaking the film, so as to vary the curvature of the liquid lens so formed. Such a lens, though far from perfect, may be made to give a magnifying power of nearly 5 over a small field.

It is conceivable that some of the very fine work done in Egypt, long before the invention of "optical" glass, may have been made possible by the use of a liquid lens of this kind. The phenomenon might easily have been accidentally observed; for even a drop of water lying on a greasy surface gives a small but appreciable magnification of the surface which it covers.

By using a thicker wire (about 2 mm. diameter) and less liquid, a diminishing lens may be made in the same way.

R. A. S. PAGET.
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August 14.

Baluchitherium osborni and its Relations.

By C. FORSTER-COOPER.

THE history of the discovery of the various fragments of Baluchitherium, which have enabled Prof. Osborn to make the preliminary restoration here reproduced (Fig. 5),[1] is interesting. In 1910 the present writer was fortunate enough to obtain bones of numerous extinct animals in the early Miocene deposits of Baluchistan. Nearly all of the animals were strange and, except for such of them as had previously been

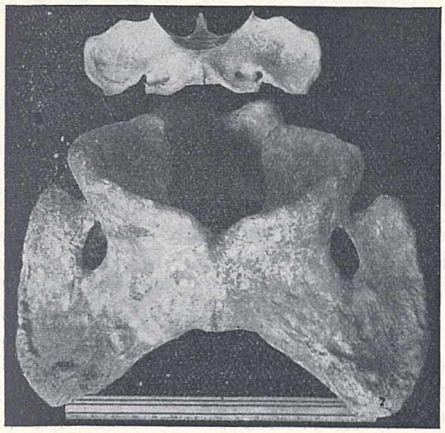


FIG. 1.—Atlas of Baluchitherium with one of a modern rhinoceros.

obtained by Dr. Pilgrim of the Indian Geological Survey, were previously unknown. Among them an atlas, the first bone of the neck (Fig. 1) and an astragalus, one of the principal bones of the ankle, were of such astounding size as to proclaim themselves as belonging to an entirely new form of mammals, and one larger even than the elephant. Beyond the fact that the bones belonged to the Perissodactyla, a group which includes the horses, tapirs, and rhinoceroses, together with some extinct families, nothing further at the time could be said of them.

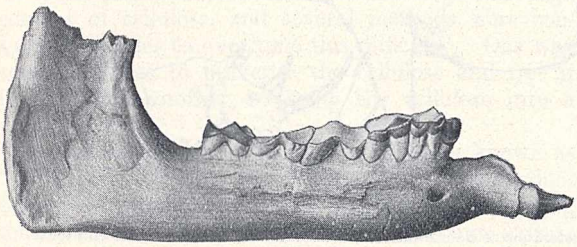


FIG. 2.—Lower jaws of Paraceratherium, showing the unusual feature, for a rhinoceros, of procumbent lower tusks. The length of the actual specimen is 30 inches.

During an expedition to the same place in the following year further remains were obtained, which comprised other vertebræ, limb and foot bones of this large animal, together with teeth of a large but primitive rhinoceros, some fairly complete skulls, and a lower jaw of a size to correspond with the skulls. The lower jaws, although obviously belonging to a rhinoceros of some sort, and one of considerable size, showed a unique feature in that the two front teeth were modified into a pair of stout, downwardly turned tusks (Fig. 2). Neither skulls nor jaws appeared to be of sufficient size to belong to the animal which possessed the atlas. In fact, the former animal appeared to be nearly twice the size, and on these grounds separate genera were made, Baluchitherium for the larger form and Paraceratherium for the smaller.

A few years later the Russian palæontologist Borissiak discovered the remains of a very similar large animal in Turkestan, which he named Indricotherium, but he likewise failed to get the skull. This regrettable lacuna in our knowledge has within the last few years been filled by the discovery of a nearly complete skull in Mongolia, a discovery which we owe to Granger, of the American Museum of Natural

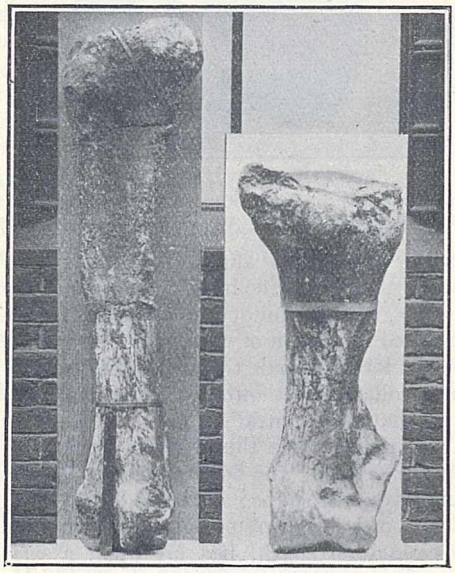


FIG. 3.—Femur and humerus of Baluchitherium.

History's expedition to China. This skull is five feet in length, and thus all requirements as to size are abundantly filled, and with it enough bones from Baluchistan, Turkestan, and China (the wide separation of these areas shows the great range of distribution of the animal in former times) are known to enable us to make an approximate restoration, and to give us a reasonable idea of what the animal looked like while still alive.

Baluchitherium on reconstruction proves to be a very strange animal. The limbs are as large as those of an elephant, and in some points are not unlike them (Fig. 3). The feet, however, are entirely different in structure, the fingers and toes, of which there are only three to each foot, are much flattened, while the metacarpals and tarsals are enormously elongated (Fig. 4), so much so that the wrist is elevated nearly a yard above the ground, three times as high as the corresponding measurements in the elephant. Of the three toes, the central one is much the largest, the two lateral ones being pressed close to its sides, rather like the splint bones of the horse, though here the side toes are complete. There are some very curious, and as yet not fully understood resemblances to the horse in

[1] Prof. H. F. Osborn in *Natural History*, vol. xxiii. (New York), gives an excellent and fully illustrated account of Baluchitherium and its relations to other rhinoceroses. There is also a figure of the skull found in Mongolia.

certain of the foot bones, and notably in the neck. The neck bones, in fact, of all the many animals with which Baluchitherium has been compared, come

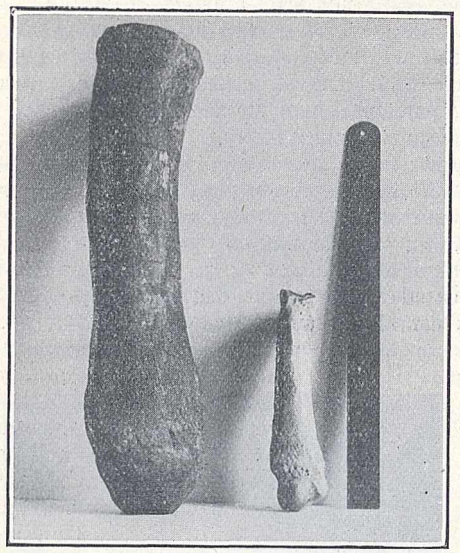


FIG. 4.—Toe bone of Baluchitherium, 15 inches long, with the corresponding bone of a modern rhinoceros for comparison. Larger bones than the one figured have been found.

nearest in proportions and shape, though of course not in size, to those of the horse. They show, however, one feature, which is unique in mammals and can only be paralleled in certain of the gigantic extinct reptiles, in that the lateral canals through which a blood-vessel runs are hollowed out into large cavities. These are so large that the central portion of the vertebra is reduced to a thin vertical partition, and in section [2] the bony parts of the centrum have a I shape; in fact Baluchitherium, in order to combine lightness with the necessary strength, has hit upon a design well known to engineers in the construction of girders.

Owing to the size of the limb bones and the height of the feet, Baluchitherium must have stood from twelve to thirteen feet from the ground, and with its horse-like neck and five-foot skull, an enormous skull length for a land mammal, must have had an over-all length of at least twenty-three feet! One curious point in all this bulk is that the head seems almost too small for the body!

The gigantic size of this animal can best be seen from the figures of Prof. Osborn [3] of his restoration of Baluchitherium (Fig. 5) compared with a white rhinoceros drawn to the same scale. It will be noticed that Baluchitherium, as restored, is considerably higher in the fore than in the hind quarters. This is a perfectly reasonable restoration on the assumption that the animal very probably fed upon the leaves of trees, but until the limb bones of a single animal are obtained it cannot be proved. An alternative restoration, also by Prof. Osborn, more on the lines of an ordinary rhinoceros, gives a somewhat different appearance.

The relationships of this animal are at present obscure.

It is certainly a rhinoceros, but unlike any known form, modern or ancient. In the teeth and skull, except for strong downwardly turned upper tusks, it is like the extinct hornless Aceratherine rhinoceroses, but the "horselike" features of the feet and neck preclude any close connexion. There is no suggestion of any but superficial resemblance to the horses, from which the tooth structure alone would at once exclude it. In fact it will be necessary to go back a long way in time to find the starting-point of Baluchitherium, and this point is at present unknown, although the present writer has suggested the little Eocene Triplopus, a rhinoceros-like animal with certain horse-like features in its limbs, as a possible signpost.

In his reconstruction Prof. Osborn has restored the fragment of lower jaw on the lines of the lower jaws of Paraceratherium (Fig. 2). The relations of these two forms are not yet clear. Baluchitherium is nearly twice the size of Paraceratherium, which is rather too large to be accounted for as a sexual difference. Moreover, there are a number of differences in the skull and teeth which render it probable that the forms are really different. It is much to be hoped that the American expedition will be successful in finding the front part of the lower jaw of Baluchitherium, which will go far to decide the point.

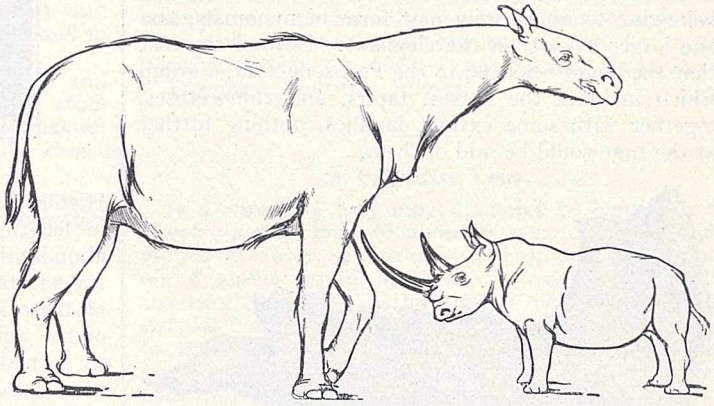


FIG. 5.—Restoration of Baluchitherium, with outline of the white rhinoceros for comparison. (After Osborn.)

[2] A cast of one of these vertebræ in section, together with the original bones of Baluchitherium, can be seen in the palæontological gallery of the British Museum (Natural History).

[3] *Loc. cit.*

Nutrition Problems during Famine Conditions in Russia.

By Prof. BORIS SLOVTZOV, Professor of Biochemistry at the Medical Institute for Women at Petrograd.

I AM glad that it has fallen to my lot to be one of the first physiologists to get through the cordon which has almost come to be considered as a kind of a second Chinese Wall. Russian scientific men have been cut off from Europe for about eight years, and have therefore been obliged to follow their scientific work in their own way.

Now that we are gradually becoming aware, through the literature and by means of personal observation, of the intensive work that has been done in the West,

especially in England and America, we realise to our dismay how much we are behind in our results, and how bad are the conditions under which we are working and are likely to work for some time. We have, however, in accordance with our possibilities, achieved a certain amount of work which, I hope, may be of interest to our colleagues in physiology and physiological chemistry. I can only give the main results we have obtained, but it provides an insight into the trend of scientific thought which has prevailed in Russia during the period of isolation.

Soon after the post-War conditions had brought about a state of affairs in which it became difficult to feed the population and the available food became less and less, Russian scientific men were faced with the task of investigating various nutrition problems. A number of emergency substitutes such as bran, oil-cakes, straw, etc., were suggested to the public. It became necessary, therefore, to establish a standard according to which the nutritive value of the different substitutes could be assessed. As in Germany, it became at first necessary to prepare bread with various grasses and to mix large quantities of potatoes in the flour. The conditions under which a bread could be prepared that could be employed as a basal-food product had to be worked out. It became necessary to make use of the experience of other countries, especially Austria. At one time the advisability of feeding on whole-meal bread, as was done in Italy, was considered. This, however, was found unsuitable and uneconomical. Then we had to set to work in order to find out how a number of natural foods such as plants and roots, *Lichen islandicus*, *Laminaria digitata*, could be utilised. With this purpose in view, a series of metabolism experiments were carried out with bread to which these substitutes were added. The most successful results were obtained with Laminaria, of which 70 per cent. was utilised by the system; 25 per cent. of Iceland moss and quantities up to 50 per cent. of various green plants were also found to be assimilated. Of course plants are not utilised well, owing to the high content of cellulose, and several methods were considered in order to overcome this difficulty. One way considered was to pulverise the cellulose and free it from lignin; another, to bring the cellulose into a soluble state.

In this connexion a Swedish preparation known as "Swedish flour" was of interest to us. This product consists of pure cellulose and is ideal in its physical consistency. It is light, porous, and does not irritate the intestine in the slightest degree. Metabolism experiments have, however, revealed that the output was equal to the intake, and that there was no utilisation of the product. Occasionally the output was less than the intake, and in these cases the deficit could be accounted for quantitatively as methane in the expired air.

The attempt to utilise bran in its entirety was of greater interest. The bran was mixed and fermented with lactic organisms at 40-45° C. for 15 hours. The cell-membranes were thus disorganised and the cell contents were made available. This can also be attained by means of autolysis by increasing the acidity with lactic acid to a strength of 0·1-0·15 per cent. When autolysis is complete, flour can be added and the mixture made into dough and baked. Bread prepared in this way was found to be utilised 5-6 per cent. better than a control bread, especially as regards protein. It contained a large amount of protein matter and vitamins. The liquid obtained by autolysing in acid medium or by fermentation with lactic organisms can also be utilised mixed with agar and gelatin as a nutrient medium for organisms.

A special commission was engaged in investigating the nutritive yeasts. The physiological and medical part of this investigation was worked out under my own supervision. It was established that *nutritive* yeast, beer yeast, and dried yeast form ideal foods rich in protein. Up to 85-90 per cent. of the material is assimilated, and palatable dishes can be prepared from it. Yeast alone cannot sustain life, as it does not contain fats and vitamin-A. If, however, yeast is mixed with a good fat it is capable of maintaining the existence of rats and mice.

Yeast, like meat extracts, promotes the secretion of the gastric and pancreatic juices, and greatly stimulates the action of salivary amylase and of trypsin. An adult organism can tolerate as much as 100 gm. of yeast without harm. Only a slight increase in the output of uric acid was observed. I am not going to discuss now the pharmacological side of this food, but I may say here that it stimulates growth in children and in animals, and that it increases the formation of hæmoglobin in blood in general.

Our interest in yeasts for nutritive purposes made us also investigate the part played by "mineral" yeasts which the Germans cultivated on ammonium sulphate and glucose. These are usually a mixture of bread yeast and *Mycoderma cerevisiæ*. They were found to be of little use for nutrition purposes.

Much more interesting were the results we obtained with the so-called "Fetthefe." The Germans wanted to utilise this substance as a source of fat, but were not successful. We adopted a different procedure from theirs. Cultures of *Endomyces vernalis* under certain conditions can produce as much as 18 per cent. fat calculated on dry matter. The investigation of the fat has shown that it mostly consists of triglycerides and resembles olive oil in composition. It is well assimilated. To prepare the fat by cultivating the organism in bottles was of course too expensive, and we adopted the following method of cultivation. Potatoes and other vegetables poor in fats and protein were sterilised and inoculated with *Endomyces vernalis*. After 5-6 days' growth the medium was dried. The product thus obtained is rich not only in carbohydrates but also in nitrogenous substance and in fat, and can, like the flour, be employed as a new article of food. As such it can be assimilated by human beings. Experiments are now in progress for the purpose of applying this process to animal nutrition.

When the famine abated the dietetic investigations became less urgent. Russian physicians and physiologists, however, collected interesting material concerning starvation. It is difficult to imagine the degree of starvation. The table below gives the official standard ration of the population according to status and age for most categories of Russian populace. Human life could not continue under such conditions, and the mortality was great.

OFFICIAL RATION, JANUARY 1, 1920.[1]

	Number of Persons.	Mean Calories per Person.
Hospitals	36,044	1805
Children's Hospitals	..	1513
Houses of Detention ?	6,214	1414
Asylums and Settlements	29,887+754	1828
Workers' dinner	..	424
Ordinary dinner	612,030	265
Children's dinner	..	408
Typhus ration	8,670	1937
Invalids' ration	1,200	1645
Ration of Red Army behind the lines	13,710	1507
Scientific specialists	..	2761
Learned men's ration	1,800	3600
Iron and wood workers	..	4600

In Petrograd and Moscow the famines were investigated in fairly great detail, and scientific material was obtained for two great conferences on the famine, the deliberations of which have so far not been published. As a president of one of these conferences I can give the most important and interesting points which have been elucidated and which are of interest from the physiological point of view.

First, the approximate weight of the body was ascertained, according to the French formula that when the length of the body in centimetres is multiplied by 0·4 the weight of the body in kilograms is obtained. We have measured the height and weight of many persons who died of starvation without any other complications, and the weight according to the formula was found to be 30-35 per cent. less than the normal. Thus the figures obtained on starving animals have been confirmed on human beings.

Chemical analysis of the organs of people who died from starvation has shown a great deviation from the normal, especially in the content of neutral and phosphorus-containing fats. There was a small decrease in weight in all organs with the exception of the brain. This had already been ascertained through laboratory experiments. Chemical analysis of the white and grey matter has further revealed a great change in the tissue of the grey matter by a large diminution, not only in the phosphorus-containing fats, but also in the general quantity of the protein. In certain cases this diminution was as much as 25 per cent. The small fall in weight in the brain can, therefore, be explained by the fact that the white matter which forms the greater part of the brain is least altered, while the grey matter is changed greatly in quantity and especially in quality.

Secondly, an experiment was carried out on a large scale to ascertain the influence of the absence of fats from the diet; a mass experiment which lasted about two years. Trading in food products was forbidden and the transport was disorganised. Consequently, a rationing system was enforced on the population. At first the rationing was restricted to bread only. After the second revolution, however, the population was divided for rationing purposes into four categories. The first consisted of workers, the second of officials, the third of the ordinary citizens, and the fourth of the former rich. The following table gives the actual rations. Afterwards every ministry undertook the rationing of their own officials, leaving the general public on the above diets. I had the opportunity of obtaining the information dealing with the amount of food served out to a certain number of people during the period of two years. From these data it was possible to calculate the fat, protein, and carbohydrates consumed per person per day and to plot mortality curves according to diet.

[1] Although these amounts represent what it was proposed by the Government to provide, no doubt the actual supply often fell short of the quantities set forth in the table.—Editor of NATURE.

THE DAILY RATION OF THE FOUR CATEGORIES OF THE PETROGRAD POPULATION.

	Protein.	Calories.
1st Category	74 gm.	475
2nd ,,	40 gm.	240
3rd ,,	33 gm.	135
4th ,,	13 gm.	53

The first maximum of mortality coincided with the general low intake of calories. During this period many people died. Before death, which occurred generally from intercurrent infections, they mostly manifested œdema. A very high mortality from insignificant causes was also registered during this period. The second mortality maximum coincides with the fat minimum. There were days when the daily fat intake averaged about 5 gm.—to all intents and purposes a fat-free diet. During this period deaths of undefined character were registered. The organs of the victims showed scarcely any change.

In the course of the famines it was also possible on several occasions to confirm the influence of the vitamins on human beings. It is interesting to record an outbreak of scurvy among various groups of people whose diet was quantitatively quite satisfactory, but lacked variety and consisted mainly of ingredients such as boiled millet, maize, etc. Such an outbreak took place in the fleet. The pathological change in the large intestine which was brought about by the one-sided consumption of millet was even named "Millet disease." The mucous membrane is penetrated by the small grains, which cause intense inflammation. By changing the diet and using large grains only this scurvy-like condition is cured. This confirms the work of American workers, showing that the physical condition of the food may be responsible for a change in the mucous membrane of the intestine, which may favour infection. Scurvy is a dietetic disease due to a deficiency of vitamin-C. and a consequent bacterial infection. No specific organism causing scurvy could be found.

Further, investigations during the famine have shown that the relative proportion of protein, fat, and carbohydrate in the diet play an important part in the nutrition of the infant. A great deal of information was obtained from infant institutions where, owing to the lack of fats, grave illnesses were prevalent, which, however, disappeared when butter was introduced in the diet. It is of interest to record the great diminution in the fertility of women and the cessation of the menstrual periods. Similar conditions were observed among animals by the veterinary surgeons.

Current Topics and Events.

IT is announced in the *Times* of August 28 that Prof. A. G. Green, director of research of the British Dyestuff Corporation, has resigned his post on account of "dissatisfaction at the lack of technical knowledge on the board of directors, and his belief that the permanent establishment of the dyestuff industry in this country is impossible under these conditions." In Great Britain it is common for power to be in the hands of people without the scientific knowledge essential to make the best use of it for industrial and social progress; and Prof. Green has proved by experience what has often been pointed out in these columns and publicly stated by scientific workers in various industrial fields. In political appointments the same principle is adopted of placing the power over scientific departments in the hands of politicians without regard to their scientific knowledge or training. Sir William Joynson Hicks has, for example, just been appointed to succeed Mr. Neville Chamberlain as Minister of Health—this being the fourth Government post he has occupied in less than a year. Though it is accepted that a Chancellor of the Exchequer should know something about finance and a Solicitor-General something about law, apparently a Minister of Health need not know anything about science in order to control the manifold activities of a department mainly concerned with scientific problems.

A SENSATIONAL report of a change of level of the bed of the Atlantic between Cape Town and St. Helena was made on the authority of the Eastern Telegraph Co. last week. It was stated that a cable repair-ship found a depth of three-quarters of a mile at a place where the chart showed a depth of three miles when the cable was laid in 1899. Changes of level of the ocean floor have often been brought to light by soundings, but the actual rise or fall is reckoned in a few feet or fathoms, and nothing of such a stupendous character as a change of more than two miles has ever been established by surveys. Decrease of depth could, of course, be caused by accumulation of the products of an eruption of a submarine volcano, and in such an event the rise of level would be local and the material would soon be worn down. Both Vesuvius and Etna began their careers as submarine volcanoes, and Sir Archibald Geikie records a number of submarine eruptions in his "Text-book of Geology," though nothing approaching the building of such a pile as would be required to produce the difference of level reported above. All that can be said at present, therefore, is that an actual uplift of the dimensions reported in so short a time is unthinkable and that the accumulation of volcanic material to produce the change of depth is extremely improbable. Confirmation of the accuracy of the old sounding as well as of the new will be required before any scientific significance can be attached to the report.

SEVERAL experiments have been made recently, both in America and in France, to instal a complete radio telephonic set in express trains. In the fast express train between Hoboken and Buffalo this has been done. Passengers can continue conversations with their friends which were interrupted by the train starting; they can also receive radio telegrams from their friends while the train is in motion. In *La Nature* for August 18, a technical description is given of the experiments which have been carried out by three of the French railway companies in making such "concert" cars. On the Paris-Orléans railway, the experimental saloon cars had two loud-speaking telephones fitted at each end of the cars. Up to a distance of 210 miles from Paris, the Eiffel Tower concerts were heard quite satisfactorily. As a rule the concerts were better heard than the news items. When the train goes through deep cuttings the sound is notably reduced, and when going through long tunnels it almost disappears. As there are at present only three large broadcasting stations in the neighbourhood of the railway, and as these are near Paris, the concert cars have only a limited use. With the arrangements used it was found that the large radio telegraphic stations near the Bordeaux-Paris line produced serious disturbances. When going round curves also, discordant sounds were heard due to the friction of the flanges of the wheels on the rails.

"CLIMBING MOUNT EVEREST," the cinematograph record of last year's attempt to scale the world's highest peak, was presented in a revised edition with several new photographs on August 27 at the Polytechnic Hall, London. Capt. J. B. L. Noel, who took the photographs, provided an interesting running commentary as the pictures appeared, while the orchestra played "Airs of Tibet and Nepal," collected in Tibet by Mr. J. Howard Somervell, one of the party of four who made the first attack on the summit. Frankly an entertainment of great and vital interest, designed to raise funds for an attempt on the peak in 1924, this pictorial account of the greatest achievement in mountaineering has been wisely chosen by Natural Films, Ltd., to inaugurate by a four weeks' season the series of travel and interest films which are to be presented to Londoners at this hall during next winter. While Capt. Noel deliberately emphasised merely the sporting nature of the climbing effort, his pictures show a much wider outlook; of particular scientific interest are pictures of the land forms and the force of the prevalent westerly winds, and also of the customs and ceremonials of the Tibetans.

THE fourth annual report of the Tidal Institute of the University of Liverpool describes further developments in the work of this vigorous young institution, though much of the work referred to is not yet ready for publication. Only a few of the more interesting features can be mentioned here. A study of the effect on the sea-level at Liverpool, of winds operating in the Irish Sea and in the Atlantic Ocean respectively, shows that their importance is in the ratio of about 2 : 3. The purely local winds seem to be less important than was hitherto supposed.

The Institute has undertaken the analysis of records for the Australasian Antarctic Expedition, 1911–1914, the Cope Antarctic Expedition, and the Gold Coast Survey. It has also prepared for the Admiralty a chart of co-tidal and co-range lines in the North Sea constructed on a new plan, namely, by calculation from the tidal current data, using the dynamical equations which connect the currents with the surface gradients. Similar methods have been applied to the tides of the northern portion of the Irish Sea. Much work has also been done on the more purely mathematical branches of tidal theory.

THE work of the National Institute of Agricultural Botany at Cambridge, though only started in the new buildings in 1921, has made sufficient progress to justify the issue of an annual journal embodying the chief scientific results obtained year by year. In the first number the director reports on the potato maturity and yield trials, from which it is already possible to draw trustworthy conclusions in spite of disturbances to the results brought about by such factors as the use of seed tubers drawn from different districts, and in some cases affected with virus disease. The barley trials, however, do not as yet warrant the publication of a detailed account, owing to unfavourable weather conditions during 1922, but it is hoped that by the end of the next season it will be possible to make a critical analysis of the experimental results. The included fifth annual report of the Official Seed Testing Station indicates that much wider use is being made of the facilities provided, 25 per cent. more persons having submitted samples, the increase in the number received from farmers being 35 per cent. An interesting innovation was a course of training in seed testing, followed by practical and theoretical examinations, several of the candidates being nominated by various seed firms. The journal (which may be obtained from the Secretary of the Institute, Huntingdon Road, Cambridge, price 1*s.* 1*d.* post free) concludes with the report of the Potato Synonym Committee and a synopsis of recent work on leaf roll and mosaic of the potato in Ireland, read before a special meeting of fellows of the Institute.

AN interesting note by Dr. R. C. Benedict upon laws introduced by various States in U.S.A. to protect rare wild plants is published in *Science* for July 20. More than forty species of wild ferns and flowering plants are protected in Vermont by an act passed in 1921; Connecticut legislated to protect the climbing fern, *Lygodium palmatum*, so long ago as 1867, and has since introduced new statutes extending the list of protected plants; it has also enacted that shipments of wild plants, legally sold as from private land, must bear definite indications of their source, while written permission from the landowner must be filed with the county officers. California protects the Toyon berries (*Heteromalis arbutifolia*) so much in demand for Christmas decoration, while practically all the wild flowers of Yosemite are protected. Massachusetts has also passed a comprehensive law, and Dr. Benedict quotes with approval the text of a plant protection law recently proposed in Illinois. The many plant lovers interested in legislation to protect British wild plants would probably find the numerous legislative experiments in this direction made by the different States a valuable source of information on the subject, especially if trustworthy information can also be obtained as to the degree of success obtained. Dr. Benedict states that evidence from both botanical and commercial sources indicates that the Vermont legislation has proved effective. Some laws have probably been badly drafted; Dr. Benedict emphasises the fact that the plant must be treated differently from the migratory animal; it belongs to the land on which it grows and, except perhaps in the case of infectious disease or poisonous plant, the State may not restrict the farmer's operations upon the land.

AT the third annual meeting of the British Chemical Plant Manufacturers' Association, held in London on July 18, the chairman (Mr. L. M. G. Fraser), in moving the adoption of the annual report, directed attention to the principal aims and activities of the Association. He said that a great deal of work has been carried out by its committee in standardising various types of chemical plants, and that consequently manufacturers have altered their patterns at considerable trouble and expense, for the ultimate advantage of chemical manufacturers. Also, the properties of chromium steel have been thoroughly investigated, and it is hoped that a continuance of the work will lead to a satisfactory solution of some of the problems connected with the use and manipulation of the alloy in the construction of chemical plant. The technical chemist is constantly needing vessels capable of withstanding higher temperature and pressure than ever before, and the Association is fully alive to the importance of watching and following up the results of metallurgical research into suitable alloys for such purposes. In particular, need is felt for further technical research on the part of ironfounders into cast-iron, with the view of obtaining a closer grained and stronger metal more capable of resisting corrosion by electrolytic action. It is hoped that the Association will be represented on the Cast-Iron Research Association and other similar research organisations. An interim report has been presented to the Association of British Chemical Manufacturers upon the training of chemical engineers, which is full of difficulties in regard not only to the framing of a curriculum but also to persuading educational authorities to adapt their methods to new requirements. The tendency of present-day education is to be too intensive; a much broader training would be of far more use to the majority of men. It is to be regretted that, owing to insufficient support being forthcoming, the Association will not participate in the Chemical Section of the British Empire Exhibition next year.

WE regret to announce the death on August 26 of Mrs. Hertha Ayrton, well known in the scientific world for her researches on the physics of the electric arc and other subjects.

DR. GEORGE H. PETHYBRIDGE, until recently head of the Seeds and Plant Disease Division of the Department of Agriculture and Technical Instruction for Ireland, has been appointed mycologist to the Ministry of Agriculture and Fisheries for England.

DR. C. E. K. MEES has described, in the Journal of the Franklin Institute for August, the way in which the Eastman Kodak Company has sought to overcome the chief difficulties that prevent "motion photography" from being available for general purposes, reducing the cost and facilitating the development, etc., of the film. The "Cine Kodak" weighs about 8 pounds and takes 100 feet of film, which is equivalent, with its smaller pictures, to 250 feet of film of the standard size. The projector is driven by a motor so that it is automatic, and has a capacity for 400 feet of film, which requires 16 minutes to show on the screen. A large saving is effected in the cost of the film by its smaller size, and a further economy is gained in the majority of cases where only one film of the subject is required, by treating the exposed film by a reversing process, instead of making the positive by printing it on a second film. But "this is quite a complicated process and requires very special and complicated equipment" to avoid the appearance of graininess on the screen, so the Company undertakes this work itself. By these means the fifteen cents per second of picture as shown on the screen, which is about the cost of a standard film, is reduced to two and a half cents per second; and as 7 or 8 seconds is a sufficient duration of exposure for a single scene (such as a waterfall or a game), the cost for one subject is about 20 cents, and this compares favourably with the cost of making a negative and one print in the ordinary way. The film base is made from cellulose acetate, so that the risk from fire that the ordinary film of cellulose nitrate suffers from is practically done away with.

A NEW edition of his work on "The Endocrine Organs" is being prepared by Sir E. Sharpey Schafer for publication by Messrs. Longmans and Co. Part 1, dealing with the thyroid, parathyroids and suprarenals, will appear this autumn, and Part 2, embracing the rest of the subject and completing the work, next year.

Our Astronomical Column.

THE TOTAL SOLAR ECLIPSE OF SEPTEMBER 10.—This eclipse is total in south-west California and the adjacent islands; also in Mexico. There is no official expedition from the British Isles, but many of the great American Observatories are sending parties to observe it. *Popular Astronomy* for June-July contains an outline of their programmes. The Yerkes, Washburn, and Goodsell Observatories are occupying Catalina Island. The Washburn party will measure the brightness of the corona by the photo-electric cell; the Goodsell party will photograph the corona and star-field with an 8-inch lens, and the flash spectrum with a grating.

Mt. Wilson and Leander McCormick Observatories will occupy two stations; at Point Loma the corona and star-field will be photographed, also the spectra of corona and chromosphere; the interferometer will be used to determine the wave-length of the green coronal line and the rotation period of the corona. Their other station is at Lakeside, near the northern limit of totality, where the flash spectrum will be photographed with concave gratings.

The Lick Observatory, and the Students' Observatory of the University of California, will work together at Ensenada. The polarisation of the coronal light will be measured, and many other researches made.

The Sproul Observatory is occupying Cuencame, Mexico, and will photograph the corona both on a large and a small scale; also the flash spectrum. The interferometer will be used to study the rotation of the corona.

The University of Toronto will study the spectrum and polarisation of the corona.

The Steward Observatory (University of Arizona) and the Mexican National Observatory will also occupy stations in Mexico.

The Lick Observatory will not repeat the Einstein investigation, believing that the question was sufficiently settled at the eclipses of 1919 and 1922. The Goodsell, Mt. Wilson, and Sproul Observatories will take star photographs for this purpose, though the star-field is a poor one—less suitable than those of 1919, 1922. Signor Emanuelli, of the Vatican Observatory, gives a list and diagram of the stars in the region in *Astr. Nach.* There are three stars (magnitudes 8·8, 8·5, 8·0) with Einstein displacement exceeding 1″; they are likely to be hidden in the corona: six stars with displacements between 1·0″ and 0·6″ (magnitudes 8 to 9); thirteen stars between 0·6″ and 0·4″; fifty-eight stars between 0·4″ and 0·2″. Some of these last are fairly bright, one being σ Leonis.

INTERNAL MOTION IN THE SPIRAL NEBULA MESSIER 33.—Mr. A. van Maanen contributes another of his important papers on internal motion in the spiral nebulæ to the *Astrophys. Journ.* for June. The measures were made on pairs of plates taken with the 60-inch reflector, the time interval being 12 years; 24 comparison stars and 400 points presumably belonging to the nebula were measured. One of the latter shows an annual displacement of 0·136″, so that its connexion with the nebula is disproved. The remaining points when plotted show consistent motions outwards along the arms of the spiral. The mean annual motion of the nebula as a whole, relatively to the comparison stars, is +0·003″ in R.A., −0·004″ in decl. The motions of the nebular points, in addition to their outward movements, indicate rotation in periods varying from 60,000 years for the inner portions to 240,000 years for the outer ones. The mean component of velocity along the nebular stream is +0·020″; it increases slightly as the distance from the centre increases.

Mr. van Maanen gives in full the reasoning which leads to the conclusion that these displacements are real. Taken in conjunction with the radial velocities measured, they indicate a parallax of the nebula of the order of 0·0005″, or a distance of 6000 light-years. The diameters of the spirals are many light-years (in some cases hundreds of light-years), but they are much smaller objects than the Galaxy.

Research Items.

SKELETON FROM AN ANCIENT WORKING IN RHODESIA.—In the Proceedings of the Rhodesia Scientific Association, vol. xxi., 1922–23, Mr. G. Arnold publishes a report by Sir Arthur Keith on a skeleton found in an ancient working near the Gwanda Mine. Sir Arthur Keith thinks that the skeleton may be ten centuries old. The remains are those of a young woman about 20 years old, and the character of the face and cranium show that she was a negro of the type so often seen among Matabele and Zulu women. It is to be remarked that the outer margins of the crowns of the more anterior teeth have been chipped during life, as if hard nuts or bones had been cracked in the mouth. One remarkable feature is the non-development of the upper wisdom teeth: they have never been formed, a common occurrence among European women, but uncommon among negroes.

A SAXON GOLD RING FROM YORKSHIRE.—Many years ago the late Canon Greenwell informed Mr. T. Sheppard, Curator of the Hull Museum, that a massive gold ring had been found in a Saxon burial ground near Driffield, East Yorkshire. Inquiries were made from a person who was believed to hold it, but in vain, until recently it appeared in the window of a Piccadilly jeweller, whence it was purchased for the Hull Museum. It weighs 15 grains and has a large oval bevel, in the centre of which is a fine garnet held by a plate of gold; the face of the ring is decorated with ornamentation made of fine gold wire. This seems to be the third record of a ring of this type, other specimens being deposited in the Ashmolean and British Museums—the two latter rings bearing the inscription "Nomen Ehlla Fides in Christo." Objects of a similar type are described by Mr. Sheppard in pamphlet No. 134 of the useful series issued by the Hull Museum.

THE EASTER ISLAND STATUES.—The interest of archæologists has been excited by the account by Mrs. Routledge of the remarkable statues of Easter Island. Mr. H. G. Beasley, in the August issue of *Man*, describes an image only 9¾ inches high, which he was lucky enough to pick up at a shop on the Continent. It seems to be of the technique of the Easter Island statues, the material being a piece of volcanic ash, once covered with red ochre, which appears to be the effigy of some worthy, in honour of whom it was smeared with red, like images in India, the red being the survival of a blood sacrifice. The domed head of the image is remarkable, as Mrs. Routledge found only one example of this type in the course of her excavations. Her inquiries show that, in addition to the great statues raised on platforms in Easter Island, a variety of smaller stone objects were made for personal use, and as niches are found in the inner walls of the houses, small images such as this may have been placed therein.

THE EVOLUTION OF THE PALÆOZOIC FLORA.—In recent years considerable attention has been given by botanists to the lines along which the Upper Devonian flora developed, and the characters of the Middle Devonian flora of the cherts of Rhynie in Aberdeenshire have given attraction and urgency to research into still older plant-remains. This point is emphasised by Dr. A. C. Seward as president of the Geological Society of London, in his address published in the Quarterly Journal of that Society for July, 1923 (vol. 79, Proc., p. lxvi). Unfortunately, he can hold out but little hope of terrestrial plant-remains of pre-Devonian age. Vegetation still clung to the swampy fringes of the continents and islands until the epoch of the Rhynie beds. It was not till Upper Devonian times (p. ciii) that it "had come into its own, and had colonized the higher and drier ground." The "change in the geological background had its reflex in the development of green foliage in place of the almost leafless condition of the older plants." The rest of this sentence ("destined to live in localities either physically or physiologically dry") seems to have got somehow out of place. In dealing with the Archæopteris flora, Dr. Seward asks how such plants were adapted to survive the long months of arctic darkness; but he feels that we are not yet "in a position to demand as a necessity either a shifting axis or a wandering crust." The critical horizon indicated by the Rhynie peat-bog has been discussed by F. O. Bower and D. H. Scott (NATURE, vol. 105, p. 681, 1920, and vol. 108, p. 153, 1921); and Dr. Scott has recently contributed a paper on the early history of the land floras (vol. 110, p. 606, 1922), which should be compared with Dr. Seward's address. Dr. Seward, however, carries the survey farther back, and reviews evidence that is rarely brought together as a whole. He remarks (p. lxxv) that Cryptozoon may be the skeleton of an animal, but is not a plant. Dr. O. Holtedahl has always viewed this genus and its allies with suspicion (*Amer. Journ. Sci.*, 4th ser., vol. 47, p. 85, and vol. 201, p. 195; see NATURE, vol. 103, p. 330, and 107, p. 795), and Dr. Seward has come independently to his conclusion that a comparison of its nodular masses with those formed of calcite in the Magnesian Limestone of Durham is fully justified. It seems that Cryptozoon, with its allies from Huronian to Carboniferous strata, is destined to go the way of Eozoon.

CRYSTAL CLEAVAGE AND CRYSTAL STRUCTURE.—Under the above title, Mr. Maurice L. Huggins has published in the *American Journal of Science* (vol. 206, p. 203, 1923) a number of diagrams and descriptions of crystal-structure, showing the probable position of electrons along lines representing bonds between the atoms, and he concludes that (i.) cleavage tends to occur so as to leave two new crystal surfaces that are electrically neutral; (ii.) if some bonds in the crystal are weaker than others, cleavage ruptures the weaker bonds in preference to the stronger ones; (iii.) if all the bonds are equally strong, cleavage will occur between the planes connected by the fewest bonds per unit area of the cleavage plane. Readers of NATURE have had their attention directed to the question of crystal strength and crystal weakness in Sir William Bragg's recent paper on crystal analysis (Supplement, June 9, 1923, p. v). Mr. Huggins conceives, however, that the splitting of a crystalline structure occurs between an atomic kernel and a group of electrons, or between two electron groups or two electrons in a pair, rather than merely between two atoms or planes of atoms. A simple illustration is seen in the two-dimensional diagram of bismuth structure in Fig. 7. The risk that we run—we who are not gifted with transcendental powers of introspection—seems to lie in regarding the circular atomic nuclei, and the smaller electron circles, in such diagrams as known physical entities, instead of as points at which something happens.

AN ANTARCTIC METEORITE.—The latest to be issued of the scientific reports of the Australasian Antarctic Expedition, 1911–14 (series A, vol. 4, pt. 1), is devoted to a description of the Adelie Land meteoric stone. The finding, on December 5, 1912, about twenty miles west of Cape Denison, of this small black object resting

on Antarctic snow was a remarkable chance. How many times since its fall from the skies it may have sunk beneath the surface by absorption of summer heat, to be exposed again by ablation, who can tell? The description by F. L. Stillwell, and very detailed chemical analysis by P. G. W. Bayly, show that the stone, which weighed originally 2¼ lb., is an "intermediate hypersthene-chondrite" containing about 6½ per cent. of nickeliferous iron.

HOT WAVES IN THE UNITED STATES.—*The Scientific Monthly* for August contains an article by Prof. R. de C. Ward, of Harvard University, on "Hot waves, hot winds and *Chinook* winds in the United States." The subject is dealt with scientifically, and the meteorological aspect is rendered of considerable interest by the graphic descriptions introduced. Hot waves or spells of excessive hot weather occur at irregular intervals, and continue for varying periods of time; they are somewhat common to the summers of the central and eastern United States. A hot wave has not acquired the official definition similar to that attached to a cold wave. The heat is caused by the southerly and south-westerly winds that prevail in the front of a weak cyclonic depression as it moves slowly eastwards across the northern tier of states, and the air, coming from warmer latitudes, causes high temperatures, accompanied by high humidity and generally hazy skies. Under the high and powerful sun the thermometer may rise well into the 90's and even to 100° F. The night is likely to bring little relief except in the mountains and on the coast, and the minimum temperatures are often over 70° F. Occasionally two, or even more, hot waves come in succession with little interruption. A prolonged hot wave is commonly accompanied by drought. Hot waves are most pronounced in July, but they are often severe in August and September, and maturing crops are often injured. A detailed description is given of *Chinook* winds, which are distinctly of the *föhn* type, and are commonly experienced along the eastern base of the Rocky Mountains; in these a rise of temperature from below zero to 40° F. or 45° F. in a few hours is sometimes experienced.

EFFECT OF WIND DIRECTION AT JERUSALEM.—The Ministry of Public Works, Egypt, has recently issued a discussion, Physical Department paper No. 10, by Mr. S. Krichewsky, on "Effect of wind direction on temperature and humidity at Jerusalem." The author quotes Biblical passages showing the effect of the different winds of Palestine. He also refers to modern information by Dr. Chaplin, who made meteorological observations at Jerusalem from 1861 to 1883. Statistical research is now made by the author, using observations from 1896 to 1913 by the Deutsch Palästina Verein published in the "Wiener Met. Jahresberichte." Observations are used for 7, 13, and 21 hours daily. The north wind which has been described as cold only causes the mean temperature to be lower in the winter than when winds are blowing from other directions; in other seasons of the year the mean temperature of this wind is above the normal; as a rule north winds are rare. The south wind is more rare than the north wind, and it seldom blows in summer; it is chiefly in spring that a south wind is warm. The east wind is reputed to be hot and very dry, its humidity is always below normal, it is rare in summer but very frequent in winter. The east wind is the principal factor of drought and it generally raises the mean temperature above normal, especially in spring when the desert winds turn into *Sirocco*. The west wind is damp as naturally as the desert wind is dry; it is the most important wind of Palestine, and supplies water vapour which produces rain or dew; the west is the most frequent wind throughout the year. The west wind is the real factor of coolness in spring, summer, and autumn.

THE ACCURACY OF VISUAL OBSERVATION AND MEASUREMENT.—The effect of the physiological properties of the eye on the accuracy of measurement is considered in a comprehensive paper by Dr. H. Hartridge appearing in the *Philosophical Magazine* for July. On purely optical grounds it is deduced that for white light and a 3 mm. pupil the images of two objects formed on the retina must be separated by 2·9 μ in order that they shall be resolved by the eye. The size of the foveal cones imposes a histological limit of 3·2 μ, in fair agreement with the first estimate. The limit to the resolving power obtained by actual experiments is not very different from this figure, results varying between 3·6 μ and 4·6 μ being obtained by using test objects of various types. An improvement of roughly 15 per cent. has been obtained by substituting pure green light for daylight. The visual acuity of the eye for the positions and movements of contours is nearly ten times greater than it is for the resolution of double points, and lines. For the movement of a contour to be perceived it must cause a cone on one side of the edge of the image to receive an appreciably stronger stimulus, and that on the other an appreciably weaker one, than before. The acuity of the eye will therefore depend less on the diameter of the cone than on its ability to perceive small changes in light intensity. Various types of linear measurements are considered in detail. The method of coincidences, as in the measurement of an object by a scale and vernier, is found by experiment to give very accurate results. The error in the setting of the image on the retina is less than 0·76 μ, corresponding to 10 seconds of arc. The interpolation method of measurement, as used in the slide-rule, is much less accurate. The errors to which these methods are liable are discussed by Dr. Hartridge, and the means of avoiding them is described. Attention is also directed to the contact method of measurement, and to measurements of depth and distance, colour and intensity.

FULLER'S EARTH.—A survey of the fuller's earth industry appears in the *Chemical Trade Journal* for July 27. The two main producers of this mineral are America and England, the whole production of the latter country coming from Somerset and Surrey. The article gives a critical survey of the properties, applications, and preparation of the mineral for the market.

THE EINSTEIN DISPLACEMENT OF SOLAR LINES.—According to Einstein's relativity theory, each line in the spectrum of an element on the sun should be displaced towards the red from its position for a terrestrial source by an amount equivalent to an increase of its wave-length of two parts in a million. In the June issue of the *Journal de Physique* M. F. Croze reviews the experimental evidence available and shows that though displacements of the order required are observed, they do not follow the prescribed law, but vary with the intensity of the line, and with the point on the sun from which the light originates. These deviations cannot be explained by the influence of pressure at the sun nor by the Döppler effect. The author is disposed to regard them as due to anomalous dispersion in the atmosphere of the sun, as suggested by Julius, and hopes to test this theory quantitatively by means of the observations now being made at Mount Wilson.

The Liverpool Meeting of the British Association.

PROGRAMMES OF THE SECTIONS.

THE provisional programmes of the various Sections of the British Association, for the meeting to be held at Liverpool on September 12-19, show that the meeting will be of decided scientific importance and interest. It will be noticed that a number of distinguished men of science from abroad are attending the meeting and taking part in discussions.

We are indebted to the Recorders of the Sections for the subjoined outline of arrangements made for sectional papers, joint discussions, lectures, excursions, and other means of recording progress and promoting critical consideration of methods, results, and principles.

SECTION A (MATHEMATICS AND PHYSICS).

The proceedings in Section A this year give promise of being exceptionally interesting and valuable, mainly because an unusually large number of distinguished foreign visitors are expected to take part. Several countries will be thus represented; France, America, Denmark, and Holland. In addition to this, Canada will have representation in the sectional president, Prof. J. C. McLennan, whose address on "The Origin of Spectra" will form an opening for a series of papers on cognate subjects, "The Correspondence Principle," by Prof. N. Bohr, "Remarks on Quantisation," by Prof. P. Ehrenfest, and "The Structure of Atoms and their Magnetic Properties," by Prof. P. Langevin, whose promised visit will compensate for his inability to attend last year on account of illness. These papers will be taken on Monday, September 17.

On the first working day, Thursday, September 13, there will be a discussion, jointly with the Sections of Chemistry and Engineering, on "Cohesion and Molecular Forces," to be opened by Sir William Bragg. This will be followed by a paper by Prof. C. G. Darwin—who has just returned from Pasadena—in which he will describe the important recent work of Prof. A. H. Compton on the scattering of X-rays. The remaining principal item on the programme will be a sectional discussion on "The Spectra of the Lighter Elements" on Tuesday, September 18. This will be opened by the president, and contributions will be made by Prof. Bohr and Prof. A. Fowler, and, probably, Prof. R. A. Millikan.

Among the individual papers which will be read may be mentioned contributions by Sir O. Lodge on "Matter and Radiation," Prof. R. W. Wood on "The Effect of Weak Magnetic Fields on the Polarisation of Resonance Radiation," and Mr. G. Stead and Miss B. Trevelyan on "The Production of Triatomic Hydrogen."

There will be papers on meteorological subjects by Capt. D. Brunt and Mr. F. J. W. Whipple, and one by Dr. A. T. Doodson on tides in relation to meteorology. Papers relating to the mathematical representation of experimental results have been accepted from Mr. T. Smith, Prof. H. Levy, and Mr. H. W. Moore.

The afternoon of September 14 will be devoted to demonstrations, including Mr. W. M. Mordey's alternating magnetism experiments and Mr. S. G. Brown's "Frenophone" or friction-operated loud-speaker.

SECTION B (CHEMISTRY).

The programme of Section B covers a wide range of subjects. The president, Prof. F. G. Donnan, will deal with the physical chemistry of interfaces, and the same subject will be followed into detail in a joint discussion between Sections B and I on membranes. A second joint discussion has been arranged with Sections A and G, the subject being cohesion and molecular forces. This will be opened by Sir William Bragg, Dr. Rosenhain, and Dr. A. A. Griffith, and an attempt will be made to bring together the physicists, the metallurgists, and the engineers in a consideration of the processes of rupture of metal test-pieces and similar matters.

There will be a group of papers on the theory of the atom, Prof. G. N. Lewis opening with an account of the chemical applications of the quantum theory, followed by Dr. Sidgwick on the Bohr atom and the Periodic Law, Dr. Coster treating the same subject from the spectroscopic side. Dr. Hevesy will give an account of his most recent work on the chemistry of hafnium. An echo of last year's discussion on photochemistry will be heard in the form of a note on the biochemical effects of polarised light from Prof. Baly's laboratory. Dr. E. F. Armstrong will open a discussion on enzymes, to be contributed to by Dr. K. G. Falk, and there will be notes on certain new points in the chemistry of cotton and of rubber. On the last morning of the meeting, Senator Ginori Conti will give an account, illustrated by slides, of the progress now being made in Northern Italy in the use of volcanic steam for technical purposes.

Other papers deal with the formation of precipitates, the functions of active hydrogen atoms in organic compounds, and the nature of the alumino-silicates. Liverpool being an important chemical centre, there will be a number of excursions of special interest to the Section.

SECTION C (GEOLOGY).

The Section will meet under the presidency of Dr. Gertrude L. Elles, whose address will be entitled, "Evolutional Palæontology in relation to the Palæozoic Rocks," and will, by her desire, be followed by a discussion. Local geology will figure largely in the programme: Prof. Boswell will give an address on the geology of the Liverpool district, and Sir Aubrey Strahan will open a discussion on the changes in the geography of the district during Pleistocene and recent times and their possible bearing on the development of Chester by the Romans and their total neglect of the now much superior waterway of the Mersey estuary. Other local papers are by Mr. C. B. Travis, on recent geological changes on the Northern Shore of the Mersey Estuary; Mr. T. A. Jones, on the Middle Bunter sandstones and their pebbles; and Miss M. Workman, on the Permian rocks of Skillaw Clough.

A discussion on metamorphism will be opened by Dr. J. S. Flett.

Other papers include Prof. Kendall on isostasy and the Pleistocene levels of Britain; Prof. Boswell on the geology of the East Denbigh Moors; Prof. Hickling on the tectonics of the Lancashire coalfield; Dr. R. L. Sherlock on British rock salt deposits; Mr. G. Slater on ice phenomena in Spitsbergen; Mr. K. W. Earle on the geology of the Windward and Leeward Islands; and Mr. C. P. Chatwin on a new gasteropod fauna from the Chalk.

Numerous excursions to places of geological interest will take place during the meeting, including an examination of the Upper Ordovician and Lower Silurian rocks of the Vyrnwy district and a whole day excursion to Holywell and other parts of Flintshire.

SECTION D (ZOOLOGY).

Prof. J. H. Ashworth, president of this Section, will take as the subject of his address "Modern Zoology: its Boundaries and Some of its Bearings on Human Welfare."

In drawing up the programme of the Section, Liverpool work in zoology, oceanography, and tropical medicine has been borne in mind. The whole of Friday, for example, will be devoted to marine zoology, comprising contributions from Dr. Johs. Schmidt, of Copenhagen, who will give a popular lecture on the scientific work of the Danish exploration steamer, the *Dana*, illustrated by cinematograph; from Dr. Mortensen and Mr. Kramp, both of Copenhagen; from Prof. Johnstone, on Rhythmic Change in the Plankton; from Prof. Dakin, who will discuss the theory of Pütter regarding animal nutrition; and from Mr. Storrow, Dr. Marie Lebour, Mr. Hardy, Mr. Carruthers, Mr. Clark and Mr. Chadwick.

On Tuesday morning there will be a series of papers bearing on the problem of the determination of sex, the contributors being Dr. Crew, Prof. Dakin and Mr. Burfield, Mr. Huxley and Prof. Carr-Saunders, Dr. Heslop Harrison, Mr. J. R. Baker, and Dr. Parkes. During one of the sessions, Prof. Hickson will open a discussion on the systematic position of the Nematoda, and Profs. MacBride and Goodrich, and Dr. Baylis, will take part in the discussion. Mr Huxley will give a semi-popular lecture on the physiology of development in the frog; Prof. Ashworth will make a contribution on the life-cycle of Rhinosporidium; Prof. Cole will explain some new points which he has brought to light in regard to the anatomy of Myxine.

Other contributors to the sectional proceedings will be Mr. J. T. Cunningham on the origin of adaptations; Prof. Poulton on a new case of mimicry; Dr. Heslop Harrison on polyhedral disease in the vapourer moths; Miss Dorothy Jackson on the Biology of a Braconid parasite of the pea-weevil; Mr. Peacock on parthenogenesis in saw-flies; Mr. Speyer on complex Aphid life-histories; Mr. Hewer on colour changes in the common frog; Dr. Baylis on the host-range of parasitic nematodes; Prof. Blacklock on two tropical disease-carrying flies; Prof. McIntosh on some points relating to polychaetes; Mr. Graham Cannon on the post-naupliar development of an Estherid crustacean; Dr. Grove on sexual congress in earthworms; Miss Breeze on invasion of the tissues of the higher plants by protozoan parasites.

A whole-day trip on the Lancashire and Western Sea Fisheries Committee's steamer, the *James Fletcher*, should be of interest to marine biologists, and a half-day in Delamere Forest should prove attractive to entomologists.

SECTION E (GEOGRAPHY).

The programme of Section E will open on September 13 with the address of the president, Dr. Vaughan Cornish, who will speak on the geographical position of the British Empire. The remainder of the morning will be occupied by papers explaining the local geography of the Liverpool district. Papers of this nature have been a feature of Section E for some years, and have been appreciated by visitors from a distance. In view of the location of this year's meeting, endeavours have been made to secure contributions dealing with Imperial geography, a question affecting the world-wide interests of Liverpool. Mr. O. H. T. Rishbeth will speak on Australian railway development, Miss B. S. Hosgood will discuss post-War emigration from the British Isles, and Mr. W. H. H. Arden-Wood will contribute a paper on the alluvial lands in India in relation to man and his activities. Other papers include the historical geography of Belgium, by Prof. L. W. Lyde, the Alps of Chinese Tibet, in which Prof. J. W. Gregory will deal with the important results of his recent journey, and the high plateau of Brazil by Mr. R. R. Walls. Rev. W. Weston will give a lantern lecture on the influence of geographical environment on the characteristics of the Japanese, and Prof. J. L. Myres will lecture on the Marmora region. Two joint discussions have been arranged with Section H, on the place of man and his environment in the study of the social sciences, which will be opened by Prof. J. L. Myres; and with Section L, on geography as a basis for a general science course, which will be opened by Sir Richard Gregory. Several excursions of geographical interest have been arranged, and there will be an exhibition of maps of the district prepared by members of the Liverpool Regional Survey Association.

SECTION G (ENGINEERING).

The subject of the presidential address in this Section is "Transport and its Indebtedness to Science"; a new departure is being made by devoting the remainder of the morning (Friday, September 14) to papers on various branches of the same subject by experts in these several branches; Mr. Berriman, of the Daimler Co., will deal with road transport; Mr. Wall, of Liverpool, with sea transport; Mr. O'Brien, of the L.M. and S. Rly., with rail transport; and Gen. Sir Sefton Brancker with air transport.

On the morning of Thursday, September 13, Section G joins with Sections A and B in a discussion on "Cohesion and Molecular Forces." In the afternoon a joint discussion is being held with the Psychology Section on the subject of "Vocational Tests in the Engineering Trades," to be opened by a paper by Messrs. Fleming and Brocklehurst, of the Metropolitan-Vickers Electric Co.

Monday, September 17, is being devoted mainly to papers on mechanical and general engineering, while most of the papers on electrical engineering will be read on Wednesday, September 19. Tuesday morning begins with a joint discussion with the Education Section, on "The Teaching of Dynamics," opened by Sir J. B. Henderson; the remainder of the morning is to be devoted to the report of the committee on complex stresses, which includes a number of important papers by various members of the committee.

Among the papers to be read on Monday and Wednesday are the following: The conservation and control of our national water resources, by Mr. J. Parry; the recent developments in excavating machinery, by Mr. Barnes, of the Ruston Hornsby Co.; smoke abatement, by Mr. Kershaw; the electric propulsion of ships, by Mr. Clough, of the British Thomson-Houston Co.; and high-power mercury rectifiers, by Mr. Morrison. All these papers deal either with subjects of great importance at the moment or with those on which great advances have recently been made.

Capt. Slee, of the Marconi International Marine Communication Co., will describe the recent developments in the application of wireless telegraphy to shipping; and Mr. Scott-Taggart will read a paper on receiving apparatus for broadcast reception. Prof. W. M. Thornton will read a paper on the mechanism of gas ignition, and will describe a new method of lighting coal mines which greatly reduces the danger of explosion.

Dr. T. F. Wall will describe a new type of induction motor which, although of the squirrel-cage type, has many of the advantages of a slip-ring motor. Prof. Marchant will read two papers, one on a method of improving the wave-shape of an alternator, and the other on the triple-frequency currents which occur in the earth-return of three-phase cables. A paper on water turbines is being read by Dr. H. Mawson, and another on the strength of forked connecting rods by Mr. W. J. Kearton.

SECTION H (ANTHROPOLOGY).

Mr. Percy E. Newberry's presidential address to the Section will be on "Egypt as a Field of Anthropological Research," and will deal with the origins of Egyptian civilisation, showing that its elements are not all native to the soil. Mr. Newberry will also deal *inter alia* with aspects of Egyptian culture in opening a discussion on "The Origin of Domesticated Plants and Animals." A second organised discussion in a joint session with the Geographical Section will deal with "The Place of Man and his Environment in Sociological Studies," to be opened by Prof. J. L. Myres. Sir Arthur Evans will embody, in a consideration of "Crete as a Stepping-stone of Early Culture," some extremely important discoveries recently made by him in that island. Mediterranean archæology will also be represented by two communications from Mr. Stanley Casson on "The North Ægean Coast in the Bronze Age" and "Prehistoric Sites in the Dardanelles and Bosporus."

In British archæology several papers will deal with Welsh prehistory, including a general survey by Prof. H. J. Fleure, and an account of "The Hill-forts in North Wales and their Historical Background," by Dr. R. E. Mortimer Wheeler. Prof. E. Ekwall, of Lund University, will discuss "The Early History of Lancashire in the Light of its Place-names."

In ethnography, Mrs. Scoresby Routledge, in "Mangarevan Folk-lore," will give an account of some results of her recent expedition to the Austral Islands and Mangareva; Mr. E. Torday will describe the methods of native traders in Central Africa, and will give an account of Hungarian folk-music, with instrumental and vocal illustrations. Mr. Torday has also arranged for a band of Hungarian gypsy musicians to perform at an evening soirée. This will give added interest to Dr. John Sampson's paper on "The Origin and Early Migrations of the Gypsies." The Near East will also be represented by Baron F. Nopsca's account of "House-building and House Implements in Northern Albania." Among a number of other interesting communications, space will permit mention only of an account of the culture of the stone-using peoples of Central Celebes by Dr. A. C. Kruyt, who has recently returned from an expedition of scientific investigation in that island.

SECTION I (PHYSIOLOGY).

The scope of Section I, comprising, as it does, physiology, histology, experimental pathology, experimental biology, and a good deal of biochemistry, is very wide, as the list of papers shows. The presidential address by Prof. G. H. F. Nuttall, on "Symbiosis in Animals and Plants," is a good example of this broad outlook. One of the most attractive items on the programme is a lecture on "Insulin and its value in Medicine," by Prof. J. J. R. Macleod, who has been closely associated with this remarkable discovery of the treatment of diabetes, made in his laboratory in Toronto by Prof. Banting and Dr. Best. On the medical side there are also papers by Dr. S. Monckton Copeman, of the Ministry of Health, on "Diet and Cancer"; by Prof. J. M. Beattie, on "The Action of Finely Divided Particles of Slate, etc., on Toxins"; by Prof. H. E. Roaf and Dr. F. W. Edridge-Green, on colour vision; and by Dr. M. C. Grabham, on "Dental Caries at Porto Santo."

The more academic aspects of physiology are represented by papers by Prof. H. Zwaardemaker of Utrecht, on "Bioradioactivity and Humoral Environment"; Prof. R. Magnus, of Utrecht, on "The Action of Carbon Dioxide and Adrenaline on the Bronchi and Pulmonary Vessels"; Prof. H. E. Roaf, on "The Analytical Mechanism of the Cochlea"; Prof. J. S. Macdonald, and collaborators, on the physiology and energetics of walking; Prof. J. S. Macdonald and Dr. F. A. Duffield, on the physiological cost of cycling; Dr. W. Waller. on the "Red Blood Corpuscles"; and Prof. C. Lovatt Evans, on the "Contraction of Plain Muscle."

The more physical and chemical side will take the form of a discussion, with the Chemistry Section, of "The Physico-Chemical Properties of Membranes in their Relation to Physiological Science," and papers by Dr. S. C. Brooks (representing the American Association) on "The Electrolytic Conductance of Micro-Organisms"; Dr. E. B. R. Prideaux, on "Membrane Potentials"; Mr. T. C. Angus, on "A Recording Katathemometer"; Prof. W. Ramsden, on "Coagulation of Albumin at Free Surfaces"; Prof. W. Ramsden and Mr. J. Brooks, on "Factors determining which of Two Liquids form the Droplets of an Emulsion"; Prof. W. Ramsden, on "Adsorption Films"; Dr. R. Coope and Prof. W. Ramsden, on clinical chemical tests; and Prof. H. E. Roaf, on "The Oxygen Content of Methæmoglobin." Some of these will be of the nature of demonstrations, and histology will be represented by a cytological demonstration by Prof. Charles E. Walker and Miss F. M. Tozer.

SECTION J (PSYCHOLOGY).

The psychological topics to be discussed this year in Section J are, in the main, similar to those presented last year at Hull. A large number of the papers have a definite and practical bearing on education and industry. Special stress is placed in several papers on the importance of individual differences. This is explicitly so in the presidential address by Mr. C. Burt entitled "The Mental Differences between Individuals—with special reference to Applied Psychology in Education and Industry."

The connexion between psychology and other sciences is again clearly shown by the titles of the joint discussions. With Section F (Economics), "The Inter-connexions between Economics and Psychology in Industry" will be discussed; and an endeavour made to study the psychological factors entering into the economic field. With Section G (Engineering), "Vocational Tests for Engineering Trades" will be described. With Section L (Education), "The Delinquent Child" will be studied—the papers dealing largely with a classification of the commoner delinquencies according to their psychological nature.

A glance at the programme shows that there are two topics of great interest both to education and to industry which receive special treatment, namely, (1) vocational guidance and vocational tests; (2) mental efficiency and fatigue. Important in this connexion will be the results presented by research workers of the National Institute of Industrial Psychology, notably in a paper on "The Conception

of Fatigue," by the director of the Institute, Dr. C. S. Myers.

In addition to the sessional programme, a series of afternoon lectures and lecturettes have been arranged; and a Citizens' Lecture entitled "Skill in Work and Play" will be given by Prof. T. H. Pear.

SECTION K (BOTANY).

This Section will meet under the presidency of Mr. A. G. Tansley, whose address will deal with "The Present Position of Botany." Most branches of botany are well represented in the programme, and, as in recent years, papers of a cognate nature will be grouped together so far as possible. The only joint discussion arranged this year is one on "Virus Diseases of Plants," in which Sections K and M will meet. This discussion will be opened by Dr. Paul Murphy, who will be followed by Prof. H. M. Quanjer, the eminent Dutch investigator of these curious maladies. One morning session will be devoted to morphological problems, including papers by Dr. D. H. Scott and Prof. Lang on the organisation of vascular plants considered in the light of fossil history. Prof. Seward will speak on the Cretaceous floras of Greenland. Plant physiology will again be strongly represented, among others, by Dr. F. F. Blackman on "Oxidation and Respiration," by Prof. Dixon on the "Extraction of Sap by means of Compressed Air," and by Prof. V. H. Blackman and his colleagues on "The Effect of Electric Currents on Plant Growth." A discussion will take place on "The Effect of Soil Sourness on Plants," in which most of the chief British ecologists will take part. There will be a considerable number of papers on cytology and mycology, also communications on floral morphology by Miss Saunders and Prof. J. McLean Thompson. In addition, a large number of papers of a miscellaneous nature will be presented. The popular lecture will be given this year by Dr. W. L. Balls on the appropriate subject of "Cotton."

Several interesting excursions have been arranged, including visits to the West Lancashire sand dunes and to Ingleborough. As in the last few years, opportunity will again be afforded for the display of botanical specimens of special interest in one of the rooms of the Section.

SECTION L (EDUCATIONAL SCIENCE).

The president of the Education Section for the meeting at Liverpool is Dr. T. P. Nunn, principal of the London Day Training College, who is taking as the subject of his address "The Education of The People"; following the examples of his two predecessors, Dr. Nunn wishes the address to be followed by a discussion, and this will be opened by Prof. Campagnac. The first paper on Thursday, September 13, will be read by Prof. O. Jespersen, of Copenhagen, a scholar of wide reputation, upon "Grammar and Logic," and a large audience is expected to hear him. The morning of Monday, September 17, will be devoted to a joint meeting of psychologists and educationists to discuss the subject of "The Delinquent Child." The chair at this meeting will be taken by Mr. C. Burt, psychologist to the London County Council and president of the Psychology Section, who has made a special study of the problem; he will be followed by Dr. Gordon, of Bath, Dr. Potts, and Miss Crossland. This discussion, which arises out of that upon psychoanalysis last year at Hull, is expected to be one of the most popular of the meeting. On the afternoon of the same day, there will be a joint discussion with the Section of Geography on geography as a basis for a general science course. The report of a committee appointed last year upon this subject will be presented.

On Tuesday, September 18, Bishop Welldon, Dean of Durham, will raise the question in a paper as to how far the value of education in elementary schools has corresponded with the increase of expenditure upon it, and it is probable that a very animated discussion will follow the paper.

During the past two years, several Sections have tried the experiment of having semi-popular lectures in the afternoons. The Education Section is following this example at Liverpool, with a paper upon "The Education of Children in Music," by Dr. C. S. Grundy, who will be assisted by a full professional orchestra, kindly arranged by Messrs. Rushworth and Dreaper, of Liverpool. There will also be a paper by Miss Margaret Einert upon "Rhythmic Dancing," illustrated by a demonstration. Each of these papers will be read at 5 o'clock, the former on the Thursday, the latter on the Tuesday afternoon.

Other topics to be considered are education and business life, the older children in elementary schools, literary appreciation in elementary schools, and the teaching of dynamics.

SECTION M (AGRICULTURE).

The meetings of Section M will be held under the presidency of Dr. C. Crowther, principal of the Harper Adams Agricultural College, whose address on "Science and the Agricultural Crisis" will be given in the morning of Thursday, September 13. Two papers from Dr. Stenhouse Williams and his co-workers at the National Dairy Research Institute at Reading will precede the president's address. After the address Mr. Hay will read a paper on agricultural economics and the development of agricultural education.

On Friday, September 14, the work of the Section will begin with two papers on frit-fly problems by Dr. Fryer and Mr. N. Cunliffe, and these will be followed by a joint discussion with Section F (Economics), in which the subject will be "The Economic Outlook for British Agriculture." The speakers in this discussion will include Mr. Forrester and Mr. A. W. Ashby.

On Saturday it is proposed to visit the Lactose Factory at Haslington, and typical cheese-making farms of that area later in the day.

The following Monday morning will be devoted to papers dealing with problems of interest from the side of physical science. The local sectional secretary, Mr. E. Rideout, will speak on the soils of Wirral, and Prof. Sven Oden, of Stockholm, on his apparatus for the mechanical analysis of soils. Different aspects of the soil water and of the soil solution will be dealt with by Mr. E. A. Fisher, of the University of Leeds, and by Prof. Hoagland and Prof. Burd, of the University of California. In the afternoon an excursion will be made to farms of the Wirral peninsula.

The concluding day of the meeting will be devoted to a discussion with Section K (Botany) on the virus diseases of plants, at which the principal speakers will be Dr. Murphy, Dr. Quanjer and Dr. Brierley, followed by a paper by Mr. G. D. Miln, of Messrs. Gartons, on the commercial value of indigenous strains of pasture grasses. Mr. Atkins and Mr. Fenton will discuss the relation of soil acidity to the natural distribution of certain pasture plants. The work of the Section will conclude with a visit to Messrs. Gartons' seed establishment at Warrington, which should form a fitting conclusion to what promises to be a sectional meeting of exceptional interest.

The Hydrogen Molecule.

By Prof. H. STANLEY ALLEN.

MODELS for the representation and elucidation of physical phenomena have played an important part in the advancement of science. Mathematicians, who employ the method known as "the ignoration of co-ordinates," may be satisfied with either a kinetic or a static model for an atom or a molecule, but the physicist and especially the chemist will, as a rule, prefer a static model. Sir J. J. Thomson [1] has done much to bridge the gap between chemistry and physics by making a serious attempt to show how, on the electronic theory of matter, atoms may be linked together to form the stable system which constitutes a molecule. To avoid the difficulties inherent in the view that the electrons are in orbital motion, he is led to postulate a more complicated law of force than that of the inverse square of the distance. For example, he considers the result of assuming a repulsion varying inversely as the cube of the distance superposed on the ordinary electrostatic attraction between a positive charge and an electron. Such a law of force may be adjusted to meet the requirements of the quantum theory. Dr. Irving Langmuir [2] has shown that a model of a static hydrogen atom may be obtained possessing many of the properties of the Bohr atom with its circling electrons, if it be assumed that, in addition to the Coulomb force between charged particles, there exists a "quantum force" given by

$$F = \frac{1}{mr^3}\left(\frac{nh}{2\pi}\right)^2,$$

acting between an electron (mass m, charge e) and a nucleus. In this formula n is an integer, and h is Planck's constant. When the electrostatic attraction, e^2/r^2, between electron and nucleus is balanced by the repulsion due to the "quantum force," the stationary electron is in stable equilibrium at a distance from the nucleus $r = a_n$, where

$$a_n = \frac{1}{me^2}\cdot\left(\frac{nh}{2\pi}\right)^2,$$

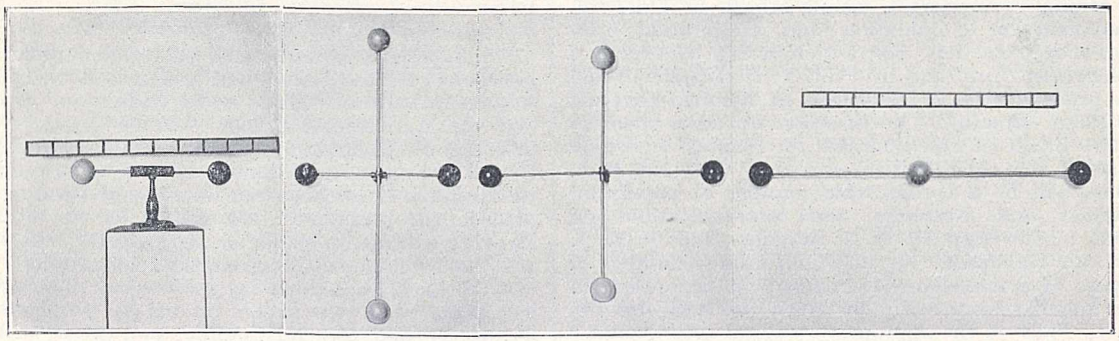
which is the radius of a circular orbit in Bohr's theory of the hydrogen atom. When $n = 1$, we obtain the normal hydrogen atom represented in Fig. 1 (*a*), in which the black ball stands for the positive nucleus, or "proton," the white ball for the negative electron. The scale above the model represents one Ångström unit, that is, the one hundred millionth part of a centimetre. The distance between the centres of the spheres is 0·531 Å.U., with an error of perhaps one or two units in the third significant figure. No physical meaning is to be attached to the size of the spheres themselves.

In a paper published by the Physical Society of London [3] the writer has pointed out that a force of exactly the type required in Langmuir's theory is provided by the quantum mechanism described by Prof. E. T. Whittaker.[4] Thus a static atom may be obtained by transferring the motion of the electron in Bohr's atom to the rotation of a "magnetic wheel" in the quantum mechanism. The question then suggested itself whether it might not be possible to obtain a static model of the hydrogen molecule by endowing the nucleus or the electron with a magnetic wheel. After considering various possible cases of this kind which gave models not differing greatly in scale from what might be expected on experimental grounds, it appeared that the simplest and probably the most accurate results were obtained by postulating the existence of a "quantum force" of the kind introduced by Langmuir, but exerting repulsion or attraction according to the sign of the electrical charges between which the force acts. It will, then, be assumed that in addition to the electrostatic force, e^2/r^2, between elementary charges, there exists a "quantum force"

$$F = e^2\cdot\frac{a_n}{r^3},$$

which is repulsive for unlike charges, but attractive for like charges.

Before considering the configurations obtained on this basis, it will be well to recall the model of the hydrogen molecule devised by Prof. Bohr. This is represented in its most stable form in Fig. 1 (*b*) on the same scale as was employed for the hydrogen atom. The two electrons (white balls) spin round in a circular orbit in a plane bisecting at right angles the line joining the hydrogen nuclei. The electrons, which are always at opposite ends of a diameter of the circle, have each an amount of angular momentum, $nh/2\pi$, determined by Nicholson's quantum condition. It is easy to show that an electron must be at the vertex of an equilateral triangle having as its base the



(*a*) Hydrogen atom. (*b*) Hydrogen molecule (Bohr). (*c*) Hydrogen molecule (static model). (*d*) Charged hydrogen molecule.

FIG. 1.—Models representing the hydrogen atom and molecule. Black balls represent the positive nuclei and white balls the electrons; scale above the models = 1 Å.U. (0·00000001 cm.).

[1] *Phil. Mag.*, vol. 41, p. 510, 1921.
[2] *Phys. Rev.*, vol. 18, p. 104, 1921.
[3] Proc. Phys. Soc., vol. 34, p. 198, 1922.
[4] Proc. Roy. Soc. Edin., vol. 42, p. 129, 1922.

line joining the nuclei, the length of the base being $1{\cdot}1007a_n$.

It is generally admitted that while the Bohr atom is able to account quantitatively for the phenomena associated with it, the Bohr molecule is far from satisfactory. If a "quantum force" act between each pair of the four electric charges which constitute the neutral molecule, it is possible to replace Bohr's model of the hydrogen molecule by a model with the electrons at rest relatively to the hydrogen nuclei. Various configurations of equilibrium are theoretically possible, but not all of these are stable. The most stable configuration, from the point of view of ordinary statics, appears to be that in which the nuclei and electrons are situated at the corners of a square, with the nuclei at the ends of one diagonal and the electrons at the ends of the other. The length of a diagonal is $1{\cdot}6407a_n$. When $n=1$, the length of a diagonal is 0·871 Ångström units, and this case is illustrated in Fig. 1 (*c*). Another configuration agrees exactly with that obtained from Bohr's theory and is shown in Fig. 1 (*b*), but the electrons are now at rest instead of in circular motion. In a third configuration, the positions of the charges are similar but the positions of the black and white balls must be interchanged.

It is possible that such configurations might exist for a time side by side, and such a possibility is suggestive in connexion with the varied values sometimes found in determinations of ionisation potentials. When collisions between gaseous molecules are taken into consideration, it is not easy to say what would be the most probable configuration in the final distribution. It is certainly instructive to find such a possibility of different configurations in the case of the simple hydrogen molecule, and points to the necessity of guarding against too rigid an interpretation of the phrase "gaseous molecule" in speaking of more complex gases, whether elements or compounds.

The actual existence of a positively charged hydrogen molecule is demonstrated in experiments by Sir J. J. Thomson and Dr. Aston. On the present hypothesis a stable configuration is obtained by placing the single electron at the middle point of the line joining the atomic nuclei. In the one-quantum state the distance between the nuclei is 1·239 Å.U., as in Fig. 1 (*d*). The ionisation potential for the complete dissociation of the charged molecule is 17·34 volts as against 11·87 volts on Bohr's theory. This should serve to discriminate between the two theories.

A possible configuration may be suggested for a neutral triatomic hydrogen molecule, H_3, in which the nuclei and electrons are situated at alternate corners of a regular hexagon (length of side, 0·625 Å.U.).

Some of the more important numerical data are collected in the following table; full details will appear in a paper in course of publication in the Proceedings of the Royal Society of Edinburgh.

TABLE I.

	θ.	d_1 (Å.U.).	$I_1 \times 10^{41}$.	W (volts).
Neutral hydrogen molecule	45°	0·871	6·261	30·06
	60°	$0{\cdot}584_5$	2·818	29·68
	30°	1·012	8·453	29·68
Ionised molecule		1·239	12·66	17·34
Triatomic molecule			9·726 19·452	46·25

θ = angle between the line joining nucleus and electron and the line joining nuclei.
d_1 = distance between the nuclei in the one-quantum state.
I_1 = moment of inertia in C.G.S. units for the one-quantum state.
W = work required for complete dissociation expressed in equivalent volts.

The ionisation potentials calculated from the values of W in the table are in moderately good agreement with the experimental results. A more exacting test of the accuracy of such a model is to be expected from a study of the wave-lengths of lines in the secondary spectrum of hydrogen. Even though the numerical values quoted may have to be modified, it may be claimed that it is now possible to postulate a hydrogen molecule in which the electrons are at rest instead of in orbital motion. It is obvious that the principles here employed may be applied to more complex atomic and molecular systems.

The Liverpool Observatory (Bidston).

AFTER a career of eighty years, during which the Liverpool Observatory has fulfilled the purpose for which it was designed, the Mersey Docks and Harbour Board, which is responsible for its support and management, has decided that the time has arrived when the usefulness of the institution might be increased by directing its energies into channels additional to those originally contemplated. It may be recalled that the chief objects sought in establishing an Observatory in Liverpool were the communication of accurate time to the Port and the rating of chronometers. The action of the British Association at the Liverpool meeting in 1837 contributed largely to the adoption of the necessary measures; the meeting in 1923 might give similar encouraging support to the widened programme now under consideration.

The Mersey Docks and Harbour Board considers that the facilities which the Observatory affords for the advancement of knowledge and diffusion of science and learning might be increased if a closer union could be established with the University. As a preliminary measure, it is suggested that the future administration and working of the Observatory may be advantageously entrusted to a joint committee of the Board and University, each nominating five members. This joint committee has now been appointed, the Board's representatives being Mr. C. Livingston, Mr. H. F. Fernie, Col. H. Concanon, the Marine Surveyor and Water Bailiff, the director of the Observatory; and the University nominees, Mr. C. Booth, Prof. Johnstone, Prof. Proudman, and Prof. Wilberforce.

The Dock Board and the University are actuated by a desire to effect an intimate connexion between the recently constituted Tidal Institute, the Observatory, and the department of the Marine Surveyor. The meteorological statistics collected by the Observatory are useful in extending the researches of the Institute in particular directions, while the tidal measurements conducted by the Marine Surveyor afford the necessary means for testing the accuracy of prediction. This closer co-operation has the additional advantage of removing the inconvenience of overlapping.

By utilising the existing establishment as the nucleus of a geophysical observatory, teaching could be combined with research—an extension which is not only feasible but eminently desirable. None of the past activities need be abandoned. The scientific centre would be maintained unimpaired, and its traditions continued. The greater activity exhibited, and the execution of an enlarged programme arranged

to meet modern requirements, should appeal to the intelligence of a progressive community. Meteorology would be followed on extended and more original lines. Magnetic observations, which unfortunately have never formed a part of the Observatory work, would be actively pursued, and the inconvenience occasioned by the want of accurate magnetic constants removed. The attention already given to seismometry could be increased with advantage. Classes are now held in practical surveying and geodesy, and these, at present hampered by want of room and convenience, could be more fittingly accommodated.

There is a difficulty in finding the necessary funds, especially at this juncture, but if a judicious programme is submitted to the attention of those capable of carrying it into execution, the past history of Liverpool leads one to anticipate that even this obstacle will not be found insurmountable.

The Eleventh International Physiological Congress.

NATIONAL congresses of a general scientific character, like the British Association, have been held in various countries for about a century, but international meetings, limited to a particular branch of science, present greater difficulties, and are of more recent date. The disruptive effect of the Franco-Prussian war was long felt, and the meetings of physiologists, started on the initiative of Michael Foster thirty-five years ago, were at first anxiously confined to the smaller countries, like Switzerland and Belgium. In 1898 a Physiological Congress met at Cambridge, but no meeting took place in Germany until that at Heidelberg in 1907. After Vienna in 1910 and Groningen in 1913, Paris was chosen as the next meeting-place, but the regular succession was broken by the War. The Paris congress was indeed held in 1920, but some nations, who have contributed much to physiology, were not represented. As Prof. J. E. Johansson said in an impressive speech at the closing meeting of the congress held at Edinburgh on July 23-27, many will feel grateful to its president, Sir Edward Sharpey Schafer, for the return to an earlier tradition. It was, indeed, the truly international character of the Edinburgh meeting which contributed largely to its success. For successful it certainly was, both as regards scientific interest and personal relationships. Some twenty nationalities were represented, doubtless a record for physiologists and for Scotland, if not for Britain. The membership of 460 exceeded that of the very successful Groningen meeting (if ladies, not engaged in physiological studies, be deducted).

As regards the programme, the customary informal reception was held on the Monday evening, by Sir Edward and Lady Sharpey Schafer, in the Old College of the University. At the opening meeting on Tuesday morning, July 24, addresses of welcome were delivered by Capt. Walter E. Elliot for the Government, by the Rt. Hon. Sir Thomas Hutchison, Lord Provost of the City, and by Sir J. Alfred Ewing, Principal of the University; Prof. J. J. R. Macleod, of Toronto, delivered a lecture on insulin. Then followed a panoramic photograph of the whole congress. The Lord Provost and Lady Hutchison held a largely attended reception in the evening, and two days later the Congress visited the Scottish Zoological Park; for the rest it was occupied with a crowded scientific programme of about 200 communications, which were given concurrently in three lecture rooms, with additional laboratory demonstrations in the afternoons.

The so-called New University Buildings, which mainly constitute the Edinburgh Medical School, were not planned very satisfactorily, and are not entirely up-to-date, but they possess at least one advantage: they form a compact whole round a central quadrangle, and this feature was of great value for a meeting like the present one. The lecture rooms and other resources of several contiguous departments were simultaneously available. An indicator in each lecture theatre, kept continuously up-to-date, announced what papers or experiments were in progress in the other rooms. Occasionally the communications and their polyglot discussion took more than the 15 minutes allotted to each, and not all the 36 chairmen were sufficiently strict, but in the end the programme was completed without serious delay.

In addition to the opening lecture on insulin, by Prof. J. J. R. Macleod, two other addresses were given to the whole congress. Prof. Ch. Richet, of Paris, spoke on "Les voies de la connaissance autres que les voies sensorielles; étude de physiologie expérimentale," and at the closing meeting a paper by Prof. I. P. Pawlow, of Petrograd, on "The Identity of Inhibition, as a Constant Factor in the Waking State, with Hypnosis and Sleep," was read in English by his son, Prof. W. Pawlow. On the conclusion of this paper, describing recent experimental work on conditioned reflexes, the enthusiastic audience rose to its feet to applaud the veteran physiologist, whose participation in the congress was almost prevented by the refusal of a British *visa* on leaving New York. Permission to land at Southampton (instead of Cherbourg) was, however, obtained by wireless telegraphy during the voyage, through the enterprise of an American colleague and fellow-passenger, who communicated with an English physiologist.

At the closing meeting an invitation to meet in America was conveyed by Prof. A. J. Carlson, of Chicago, as president of the American Physiological Society, and an international committee was appointed to consider the possibility of accepting it, and should the economic obstacles prove too great, to select another place for the meeting in 1926.

It is naturally difficult to single out, for individual mention here, a few of the numerous communications, abstracts of which were issued in advance, arranged alphabetically in book form. They will appear later as a supplementary number of the *Quarterly Journal of Experimental Physiology*. On the first afternoon the section dealing with insulin attracted the largest audience; here F. G. Banting and C. H. Best, of Toronto, reported that they had found insulin in normal rabbit's blood, one unit for about 30 c.c. In the vitamin meeting, held at the same time, it was evident that the subject is attracting more and more attention on the continent. K. Hotta, a Japanese investigator working at Frankfort, described how the characteristic convulsions of pigeons, fed on polished rice, may be entirely prevented by feeding with cholesterol. In yet another section W. R. Hess, of Zürich, reported on the plans for founding a station for high altitude research near the terminus of the Jungfrau railway (about 11,500 feet above sea-level). The peculiar advantage of this site is its ready accessibility, as compared with the Mosso laboratory on the Monte Rosa, which can only be reached with difficulty and during a very limited period of the year; 120,000 francs have already been subscribed, and a further sum of 100,000 francs is considered necessary. This Swiss station is not intended

only for biological work, but also for meteorology, climatology, astronomy, etc.

Among the demonstrations, one by A. N. Richards and J. T. Wearn, of Philadelphia, attracted much attention. They showed how to collect glomerular filtrate by insertion of a very fine capillary into Bowman's capsule in the frog. The crowded laboratory must have increased the difficulties of this very delicate operation. Prof. Richards subsequently explained how the minute volume of fluid was analysed by the nephelometric methods of his namesake, the chemist. The filtrate is rich in chlorides which must be re-absorbed in the tubules, and hence a decision is arrived at with regard to rival theories of urinary secretion. Similarly, Bloor's nephelometric phosphorus determination, modified by H. Winterstein, of Rostock, enabled the latter to investigate the phosphorus metabolism of the central nervous system of the frog; the phosphatides here play a considerable part.

H. J. Hamburger and R. Brinkman, of Groningen, claim that the nervous stimulation of the heart sets free substances which influence the contraction of the stomach and gut in the same way as if the nerves of these organs are stimulated electrically; they term this humoral transmission of nervous impulses.

Papers of methodological importance were communicated by A. Kossel, of Heidelberg, who has discovered in the dinitronaphtholsulphonic acid of naphthol yellow a reagent for the quantitative precipitation of arginine and for the isolation of many other bases, and by E. London, of Petrograd, who described a new method for investigating intermediate metabolism, consisting in the introduction of permanent metal cannulæ into deep-seated abdominal blood vessels.

Owing to the circumstance that a conference on the physiological standardisation of drugs met under the auspices of the League of Nations at Edinburgh just before the congress, pharmacology was well represented. At the congress, J. J. Abel and C. A. Rouiller, of Baltimore, described the further purification of the oxytoxic principle of the pituitary, which they have now obtained as a substance which is 1000-1250 times as active as histamine phosphate on the guinea-pig's uterus; the product also possesses powerful pressor and diuretic properties.

W. E. Brown and V. E. Henderson, of Toronto, find that ethylene will produce complete surgical anæsthesia, being more potent and in other ways preferable to nitrous oxide.

During the congress a number of important cinematographic demonstrations were given; perhaps the most interesting was by A. Krogh, of Copenhagen, which showed, under great magnification, the effect of various agents on capillary circulation (this film should prove of immense value in teaching large classes).

In connexion with the congress a Harvey medal, the work of Mr. Pilkington Jackson, the Edinburgh sculptor, was given to every member, and the University of Edinburgh conferred honorary degrees on eight distinguished foreign physiologists who were present, namely, Prof. F. Bottazzi, professor of physiology, University of Naples; Prof. W. Einthoven, professor of physiology, University of Leyden; Prof. W. H. Howell, professor of hygiene, Johns Hopkins University, Baltimore; Prof. J. E. Johansson, professor of physiology, University of Stockholm; Prof. A. Kossel, professor of physiology, University of Heidelberg; Prof. H. H. Meyer, professor of pharmacology, University of Vienna; Prof. I. P. Pawlow, professor of physiology, University of Petrograd; and Prof. Ch. Richet, professor of physiology in the Faculty of Medicine, Paris.

A Seventeenth Century University of London.

EVERY one knows that London was the last great capital city to be provided with a University. The reason for this is not obvious, but the fact remains that after the failure of Sir Thomas Gresham's great aspiration in the seventeenth century, the mere idea of a University seems to have been dropped until it was revived by the Benthamites in the nineteenth century. But not altogether: a solitary enthusiast now and again raised his voice. In 1647 there was a curious proposal launched in a pamphlet, now extremely rare, for remedying this deficiency. The proposal came to nought, like many educational projects, not only, we may surmise, because the country was in the grip of the Civil War, but, as will appear, by reason of certain difficulties inherent in the scheme. The title of the tract, or rather part of the title—for it is a true child of the seventeenth century, when long titles were the vogue—is "Motives grounded upon the Word of God, and upon Honour, Profit, and Pleasure for the present Founding an University in the Metropolis London, . . ." and the author chose to be known as "a True Lover of his Nation, and especially of the said City."

The True Lover is manifestly a Puritan, and his main concern is with the shortness in the supply of preachers of whom he estimates that we want more than 20,000, "and are hopeless of supply, without other provision than yet we have." The old universities, even at their prime, could not bring forth such numbers. Now was the golden opportunity for London to remedy this lamentable defect "when so many great houses may be had and made Colleges of, with so little alteration, and Pauls Church and London-House be the publike Schooles." Teachers were to be had on as easy terms as buildings: "by reason of the Warres in other Countries, you may now have the choicest of their Professours of the Arts."

But the True Lover's financial plan displays greater optimism than knowledge of human nature warrants. If every sincere Christian in London gave up one meat meal a week it would be possible to maintain, he thinks, twenty thousand "poore Schollars," and a similar abstention throughout the Kingdom an hundred thousand. This greater number by no means dismays the True Lover; on the contrary, it stirs his enthusiasm. After a general course of military training, twenty thousand of the "choycest" would be selected as ministers, the remainder being "imployed in Trades, or Navigation and show themselves for the defence of this country Lions on the Land, and Dolphines on the Seas." The elect would also "Discipline their Parishes and put all England in Israels posture so that we might be a Nation of Souldiers and defend our Religion both with Divine arguments and (if need required) with corporall Armes also."

If the True Lover had read Milton's famous Tractate on Education, published three years earlier, he had not been impressed by it, nor had he apparently breathed any of the ideas which were a few years later to bring about the first meetings of the nascent Royal Society. His notions of curricula may be described as humanistic, coloured with a pronounced utilitarianism. Three colleges were to house the hundred thousand. In one nothing but Latin was to be spoken, and in two years the scholars would thus be able to speak as good Latin as they do English. "How easily afterwards," he exclaims, "would they

attaine the Italian, French and Spanish Tongues, and in Merchandizing be fit to negotiate with the greatest Princes." In a second College nothing would be spoken but Greek, and in a third Hebrew. This would attract all "forraigne Protestants of work in this westerne World," as well as the Jews "whose conversion is now at hand."

The vision of a truly Puritan Paradise opens up. "If London were an University, such, pluming the Crest of this Royall City, would cause it to present a more glorious aspect than all the lofty Cypresses in Constantinople doe unto all that approach unto it: yea, all the yeare long cause London to resemble Jerusalem in the Feast of Tabernacles." Not only would there be a chaplain in every house of the nobility (and even "the Citizens carry one sometimes"), but every godly merchant might have a graduate in his ship, and "Sea-men (generally so prophane)" might become Saints and "their masters goods prosper in their hands."

That there will be objections from Cambridge and Oxford (the order of precedence is his and prompts a conjecture as to the True Lover's upbringing) is foreseen, but these, it can well be imagined, do not daunt such a buoyant optimism. Your True Lover, if he is worthy of the name, has as little difficulty with objections as with finance. Thus there are nine answers to the three objections ("weak, weaker, weakest"), not any of which are objections founded upon such base things as accommodation and finance. Perhaps, however, it was this sort of objection which prevailed with the Lord Mayor and his colleagues (to whom "Motives" are presented), and, as we know, the True Lover's University did not build Jerusalem in London. Which, perhaps, is just as well. E. D.

Immigration and Degeneracy in the United States.[1]

THE United States Government is taking measures to control immigration, so as to ensure, so far as is possible, that undesirables of all sorts shall be excluded. The present publication, which is the statement of Dr. Harry H. Laughlin made before the Committee on Immigration and Naturalisation of the House of Representatives, is witness to its activity in this direction. By estimating the actual and predicted proportions of various sorts of degeneracy contributed by the various stocks that enter the United States, it is possible, by excluding immigrants from those foreign countries that contribute more than their share, to ensure that the healthiest possible stocks only are admitted.

The statement of Dr. Laughlin covers feeble-mindedness, insanity, criminality, epilepsy, inebriacy, leprosy, tuberculosis, blindness, deafness, deformation, and dependency. It is found that each of these forms of degeneracy demand distinct methods of treatment. For example, it is comparatively easy to control feeble-mindedness, for it manifests itself early in life. Therefore it is found that the native white population contributes, proportionally, more than the immigrant white to the feeble-minded part of the population. On the other hand, insanity, which manifests itself much later in life, is not so easy to diagnose in the immigrant, with the consequence that the immigrants of the present generation have a higher incidence of mental instability than is possessed by the foundation families. Therefore it is proposed that immigrants should come of families with no record of insanity.

The case of crime is interesting. Those countries that have contributed least to the criminal population of the United States are Great Britain, Scandinavia, Ireland, Germany, and the Netherlands; *i.e.* precisely those that have contributed the foundation stocks. The Southern European countries have contributed a far larger proportion, and this is probably due, in the opinion of Dr. Laughlin, to a change in social environment, with a consequent social maladjustment. Since criminalistic tendencies show themselves early in life, it has been possible to exclude this type with a considerable degree of success.

The analysis of figures has made it possible to reach some interesting conclusions with regard to the contributions to degeneracy made by the different constituent elements of the population of the United States, and it is evident from this report that before long we shall know much more than we do at present about the problem of degeneracy. One definite conclusion seems to have been reached by Dr. Laughlin; he states that "custodial inadequates are for the most part recruited from a relatively small portion of the families of the whole population. This means that social inadequacy is not a result of accident or bad environment, but that primarily most custodial inadequacy is founded upon degenerate inheritance."

The ultimate effects of the prosecution of a thoroughgoing policy of immigration control will be far-reaching; for the United States will be able to absorb the healthy stocks, and to reject the unhealthy, thus greatly benefiting itself at the double expense of European countries. W. J. PERRY.

[1] Analysis of America's Modern Melting Pot: Hearings before the Committee on Immigration and Naturalisation, House of Representatives, Sixty-seventh Congress, Third Session, November 21, 1922. Statement by Harry H. Laughlin. (Serial 7-C.) Pp. 723-831. (Washington: Government Printing Office, 1923).

Fire Hazards and Fire Extinction on Oilfields.

THE subject of fire-risk, prevention and extinction on oilfields is one which the public as a whole tends to take very much for granted, only being stirred to interest by press reports of oil-well fires such as occurred in Trinidad some two years ago, when thousands of pounds' worth of damage was done, or by more serious disasters on some of the American fields, involving the loss of many lives. On the other hand, those concerned with the actual control of oilfields, if not the employees themselves, are very much alive to the ever-present danger of a conflagration arising from the high degree of inflammability of petroleum and its products, and they know, usually only too well from experience, that oil-fires, from the inherent nature of the materials involved, are by far the most difficult to combat successfully.

Prof. J. S. S. Brame chose this subject as the theme of his valedictory address to the Institution of Petroleum Technologists recently, and in view of the rapid and generally unappreciated evolution of modern methods of oil-fire extinction, especially as practised in America, his dissertation was particularly welcome. It certainly stimulated members of his audience to a keener perception of the risks run by those engaged in all branches of the industry, without in any sense being either sensational or alarming.

As with other undesirable evils, prevention being better than cure, the greatest possible care is taken nowadays to meet, by precautionary measures, the contingencies of oil-well and oil-tank fires. Unfortunately, one of the chief causes, lightning, is extremely

difficult to safeguard against, and the loss of oil by ignition of the associated gases during storms is a formidable problem, especially in certain parts of the United States. In the Mid-Continent field, for example, as much as 1,000,000 barrels of oil per annum has been lost in this way.

Preventive measures consist for the most part in the employment of specially designed storage tanks, the wooden top surmounting the metal body being a favoured form in America. This type of tank is open to the objection that continuity of metal is broken, so that perfect protection from lightning cannot be assured. In this country, all-metal tanks are preferred; sometimes steam-lines are led to the tops of the tanks for discharging steam freely at the approach of a thunderstorm, though in the case of large tank-farms the method proves impracticable. Tanks are usually built in the centre of sump-holes, while a clearance of 200 feet between the site of each tank is desirable. Probably the most recent method for preventing oil-tank fires is that concerned with the use of "Sealite," an artificial preparation consisting of a mixture of glucose, glycerin, calcium chloride, glue and starch. This mixture can be rendered lighter than oil by aeration, and when pumped into the tanks it floats on the oil, thus preventing evaporation and also combustion. The better-known "Foamite-Firefoam" system of fire-extinction is only applicable once a fire has started; this depends on the foaming reaction set up by bringing together alum and licorice, by which carbon dioxide is generated, thus effectively choking the fire.

Oilfield fire may of course be due to other causes besides lightning; the friction of the crown-pulley when bailing operations are in progress on the rig; crossed guy-lines or wires causing sparks which ignite the volatile gases; the throwing down of lighted cigarette-ends (regarded as a criminal offence in some countries—and rightly so); spontaneous combustion of gas-lines; leaky pipe-lines; all these contribute to the possible risks to be guarded against.

A somewhat novel and generally unsuspected cause of petrol-fires is the power which the mobile spirit has of generating static electricity. Ignition of volatile oils through static discharge has been known in hairdressers' shops, in garages where men have chanced to clean their hands with silk rag soaked in petrol, in filling up petrol tanks of motor cars using a piece of chamois leather for filtration purposes. A still more curious case is that of the chauffeur who was drawing from a self-measuring tank into a can bearing a wooden handle; he hung the can by this handle, thus insulating the receptacle, and under these conditions the oil caught fire on two successive occasions.

The moral of these examples is obvious. They serve to show, however, the meticulous care necessary in handling petroleum under all conditions, and it speaks volumes for the administrative and technical ability of those responsible for storage and distribution of oils, that the disasters attending oil-fires are so few, not only in Great Britain but also in America, where such vast quantities of inflammable spirit are dealt with annually. H. B. MILNER.

The Greenwich Magnetic Observatory.

PROPOSED REMOVAL TO HOLMBURY HILL.

MAGNETIC observations were commenced at the Royal Observatory, Greenwich, in the year 1840. They included absolute observations of the magnetic elements together with eye-observations, obtained at first every two hours and afterwards every hour, for determination of the variation of the elements. In 1847, continuous photographic records of the elements were introduced and have been continued until the present time. The length of this continuous series of observations provides valuable material for the study of the phenomena of terrestrial magnetism. It was by their means that Mr. Ellis demonstrated the 11-year periodicity common to the variations in the diurnal ranges of the magnetic elements and to the sun-spot period, and that Mr. Maunder established the connexion between the recurrence of magnetic storms and the rotation of the sun. More recently, Dr. Chapman, by using the Greenwich observations, combined with similar records of one or two other observatories which have a long series, has been enabled to put forward a comprehensive theory connecting magnetic storms and the regular diurnal variations of the elements with the electrification of and movements in the atmosphere, caused by the discharge from the sun of electrified corpuscles. The Admiralty magnetic charts are constructed at Greenwich, the last issue in 1922 consisting of three large-scale maps showing the magnetic variation, and three smaller maps showing the magnetic variation, dip, and horizontal intensity for the whole world.

During the last twenty years the magnetic observations have all been transferred to buildings constructed of non-magnetic materials in a special enclosure in Greenwich Park away from the iron in the Observatory. The instruments have also been modified and improved. With the growth of electric traction in the latter part of the last century, steps had to be taken to safeguard the Observatory from disturbances due to leakage currents. Since 1903, a protective clause has been inserted in all Parliamentary Bills for electric rail- or tramways running within five miles of Greenwich, and a clause requiring insulated returns if running within three miles. With these safeguards, the disturbances, though perceptible, have been kept within reasonable limits.

On the decision of the South Eastern and Chatham Railway Co. to electrify its local services which run in the near vicinity of, and on both sides of, the Observatory, the question of safeguarding the interests of the Observatory was taken up with the Ministry of Transport. It was ultimately agreed that the most satisfactory arrangement for both parties, and the cheapest for the railway company, would be to move the magnetic observatory to another site, the railway company defraying the costs of the removal and the extra cost of maintenance thereby involved. A site near London was desirable, not only so that supervision from Greenwich would be easy, but also in order to maintain a first-class magnetic station in the south-east of England. After examination of all sites within fifty miles of Greenwich which were at least three miles from any existing railway, the region which seemed to offer least probability of being affected in the future by railway extensions or building operations was that around Holmbury St. Mary in Surrey. The site finally chosen as the most suitable in the neighbourhood is on the lower slopes of Holmbury Hill.

Some opposition has been aroused owing to it being common land. The buildings to be erected on it would be low and not unsightly, and would not interfere with the amenities of the district. The fact of being on common land would, on the other hand,

afford a guarantee against disturbance by possible future building operations. The Admiralty has undertaken to meet the wishes of the Commons and Footpaths Preservation Society by acquiring an equal area of land adjacent to the common and adding it to the common so that the total area of the common will not be reduced.

Academic Biology.

UNDER the title "The Dry-rot of our Academic Biology," Prof. W. M. Wheeler delivered a most provocative address to the American Society of Naturalists, which is printed in *Science* (vol. 57, pp. 61-70). The address may have been written under the reaction from the author's labours upon a volume of 1100 pages upon ants, but it provides food for thought for the teacher of biology. The title seems to have been chosen in part with an impish desire to lead the librarian astray, so that future students of the fungi may find it "reposing unashamed between such monuments of cryptogamic erudition as the 74 folio volumes of Professor Farlow's 'Toadstools of God's Footstool' and the 27 quarto volumes of Professor Thaxter's 'Laboulbeniales of the Universe'"; in part to indicate Prof. Wheeler's foreboding as to the devastating effect of academic biology upon the young minds exposed to the danger.

Apparently 25 per cent. of the young men and women graduating in the United States have had at least the equivalent of an elementary course in botany or zoology, but of these very few exhibit a vital and abiding interest in biological inquiry. This seems to have led to this interesting analysis of the relative ineffectiveness of biological teaching (tinged, perhaps, with the after effects of eleven hundred pages upon ants!). Some of the suggested defects will certainly provoke sympathetic response in Great Britain, for instance the complaint that biologists are compelled to be most active pedagogically during the annual "glacial period," with a consequent reliance upon preserved material of convenient types and a great restriction of field studies. The mature student who, after four years in a divinity school, relinquished attendance upon a course in genetics because the professor's mental processes were so similar to those of his divinity teachers when they held forth on predestination, salvation through grace, etc., is cited as part of a general indictment which suggests the reflection that the best culture medium for the academic dry-rot fungus consists of about equal parts of narrow, unsympathetic specialisation, and normal or precocious senile abstraction. There are redeeming features, however, and the author rejects a friend's remedial proposal that staffs should be completely changed and buildings burnt out or thoroughly disinfected every 25 years! Another tendency which is deplored is the migration of the American graduate to the German laboratory and the teaching of authority, instead of spending the few precious post-graduate years among the problems provided at her door by the flora and fauna of the tropics.

Two positive suggestions for improvement are made: first, that teaching should be more ecological in a very wide sense of the term, and botany is certainly moving very rapidly in this direction in Great Britain; secondly, that opportunities should be provided for the amateur naturalist to meet the young student both in the laboratory and in the field, and so counteract the paralysing influence of academic formalism by his unprofessional enthusiasm and interest.

University and Educational Intelligence.

LONDON.—The work of the Ramsay Memorial Department of Chemical Engineering at University College will begin in October. The department has been instituted with the object of enabling young graduates in chemistry and engineering, who have already obtained a good training in the fundamental sciences of chemistry, physics, and mathematics, to direct their studies and investigations towards the application of the principles of physical chemistry to the scientific design and operation of the apparatus and processes of chemical industry in general. Mr. E. C. Williams, of the University of Manchester, has been appointed professor in charge of the department. An assistant lecturer, who must have had an engineering training, will shortly be appointed by University College Committee.

THE Folland scholarship in metallurgy, in connexion with the University College of Swansea, is to be offered in competition on September 10 and following days. The scholarship is of the annual value of 50*l*., and tenable for three years. Further particulars are obtainable from the Registrar of the College.

A LIMITED number of grants in aid to junior assistants in chemical works and laboratories in or near London, desirous of extending their knowledge of chemistry, will shortly be allocated by the committee of the Salters' Institute of Industrial Chemistry. Applications must be sent before September 15 to the director of the Institute, Salters' Hall, St. Swithin's Lane, E.C.4.

APPLICATIONS are invited by the Royal College of Physicians of Edinburgh for the Parkin prize, value 100*l*., which is open to competitors of all nations, for the best essay on "the curative effects of carbonic acid gas or other forms of carbon in cholera, for different forms of fever and other diseases." Competing essays, which must be written in English, must reach the Secretary of the College not later than December 31 next, bear a motto, and be accompanied by a sealed envelope bearing the same motto outside, and the author's name inside. It is stipulated that the successful candidate shall publish his essay at his own expense, and present a printed copy of it to the college within the space of three months after the adjudication of the prize.

MUCH of the scientific information latent in government publications fails to reach those to whom it would be of the greatest utility. An example of how such information can be made more generally accessible is the index issued by the United States Bureau of Education to documents having a bearing on the subject of home economics. This (revised March, 1923) includes not only 55 of the Bureau's own pamphlets, but several hundreds of others issued by the Department of Agriculture, the Bureaus of Standards, of Mines, and of Fisheries, the Labour Department Children's Bureau, the Public Health Service, the Federal Board of Vocational Education, and the American Red Cross.

"THE janitor of a modern school building is, next to the principal, perhaps the most important officer in the school." This pronouncement by Dr. Dresslar, an American authority on school hygiene, is quoted with approval by the author of "The School Janitor: a study of the functions and administration of school janitor service," Bulletin, 1922, No. 24 of the United States Bureau of Education. The writer goes on to show that although the average annual salary of school janitors is 980 dollars, or more than 50 per cent.

higher than that of elementary and high-school teachers, including principals, most people fail to realise the importance of this service or, indeed, to give the subject any thought at all, with the result that most janitors are selected and appointed for personal or political reasons rather than on the basis of merit, and many are incompetent and physically, mentally, and morally unfit. In view of the large control exercised by them over health conditions, especially as regards cleanliness, air, and light, their moral influence, and the high importance of their work educationally as setting standards of house-keeping and taste, and financially as affecting the preservation of valuable property, it is surprising that this is the first comprehensive study of the subject that has been published in America.

THE teaching of civics and the encouragement of activities making for good citizenship have received a large and increasing amount of attention in the United States since the War. Numerous pamphlets and leaflets issued by the Bureau of Education on "lessons in civics in the elementary grades," "preparation of teachers of the social studies for secondary schools," boy-scouts and girl-scouts, "lessons in community and national life," "Americanisation," "the teaching of civics as an agency for community interest and citizenship" (by the Commissioner of Education), etc., have recorded and stimulated the movement. The last of the series is Bulletin, 1922, No. 45 on "Status of certain social studies in high schools." This gives the results of an investigation conducted by the Bureau in 1922, and compares them with the facts revealed by a similar inquiry in 1919. Important changes have developed in the treatment of civics and economics in the schools, the tendency being to make the courses more practical and to deal with modern social and economical problems instead of merely with the machinery of government and economic theory. Of the 13,000 largest high schools of the country to which a questionnaire was sent in 1922, half sent replies, and of these 88 per cent. offer instruction in civics, most of the courses being obligatory, and 41 per cent. offer courses in economics, more than one-third of which are obligatory.

SOME recent developments in educational journalism are described by Prof. Carson Ryan of Swarthmore College, in Bulletin 25 of 1923 of the United States Bureau of Education. The technical educational journals have been hard hit by the rise in costs of production and have with difficulty held their own. Of the 144 journals listed in the bulletin not more than 10, with an aggregate circulation of less than 40,000, attempt to deal with educational problems in a national way free of associational connexions. Forty-eight State and associational periodicals have an aggregate circulation of 234,800. They include the Journal of the National Education Association, which in less than two years has attained a circulation of 130,000. Educational journalism in the daily newspapers has maintained itself effectively and improved in quality. Although the daily "school page" is still maintained by about 10 per cent. of the chief American dailies, the present tendency in newspaper treatment of education is away from such departmental methods: "educational" news should, it is considered, not be so labelled and should compete with other news for position. On the part of school and college authorities there is a marked disposition to welcome and co-operate with newspaper men. For example, one reporter was allowed to go through the schools of the city, sitting each day in a class-room among the pupils, to write a day-by-day first-hand account of schooling in all the grades.

Societies and Academies.

PARIS.

Academy of Sciences, July 30.—M. Guillaume Bigourdan in the chair.—Gabriel **Bertrand** and B. **Benzon**. A kind of physiological mutation observed in mice. During the study of the effects of the addition of a trace of zinc to the food of mice in the absence of vitamins, one mouse survived eleven weeks before showing any symptom of trouble, while all the other animals lived only from three to five weeks.—V. **Grignard** and M. **Dubien**: The condensing action of the mixed magnesium alcoholates, ROMgX. The alcoholates of the type $C_2H_5 . O . MgI$ produce energetic condensation of aldehydes and ketones, aldols being formed.—Jean **Chazy**. The field of gravitation of two fixed masses in the theory of relativity.—Th. **Varopoulos**: The number of exceptional values of multiform functions.—Ch. **Maurain**, A. **Toussaint**, and R. **Pris**: The measurement of air resistance on railway material. An account of the results of experiments carried out on a model train, one-twentieth real size.—Albert **Portevin** and François **Le Chatelier**: Obtaining, by heat treatment, light aluminium alloys of high tensile strength not containing magnesium. The effect of the temperature of tempering is given for an aluminium alloy (4·3 per cent. copper, 0·8 per cent. manganese, 0·38 per cent. silicon) and the results contrasted with alloys of the duralumin type containing magnesium.—André **Job** and Guy **Emschwiller**: The photochemical reduction of zinc sulphide. Phosphorescent zinc sulphide suspended in air-free water and submitted to ultra-violet radiation from a mercury lamp gives metallic zinc and free sulphur, some centigrams of zinc per hour being formed.—MM. **Wertenstein** and **Jedrzejewski**: The evaporation of carbon. The rate of evaporation (m) of carbon filament has been determined at temperatures between 2800° and 3500° C. absolute, and the results are in accord with the equation

$$\log m = 14.19 - \frac{47,000}{T} - 1.25 \log T.$$

From this, 5100° C. abs. is deduced as the boiling point of carbon.—P. **Lebeau**: A method of thermal fractionation of gases arising from the carbonisation of solid combustibles. The fuel is heated in a vacuum to temperatures increasing by steps of 100° C., and the gas pumped out at each stage and analysed. The results with seven fuels of different type are given in a diagram.—René **Reich**: New organometallic compounds: copper phenyl and silver phenyl. Copper phenyl has been isolated as the result of the reaction of dry cuprous iodide on an ethereal solution of phenylmagnesium bromide (in an atmosphere of nitrogen). The product is unstable, giving copper and diphenyl at 80° C. Copper ethyl proved too unstable to isolate, although there were indications of its formation. Silver phenyl was prepared by a similar reaction; under ether, at −18° C., it is completely decomposed in a few hours into silver and diphenyl.—L. **Bert**: Bromodiphenylmethane and the Grignard reaction. The main product of the reaction of magnesium on bromodiphenylmethane is tetraphenylethane.—M. **Pastureau** and H. **Bernard**: A new method of passing from mesityl oxide to tetramethylglycerol.—Alphonse **Mailhe**: The preparation of petrol starting with animal and vegetable oils. Rape oil, heated with zinc chloride, has been shown in an earlier communication to give rise to low boiling hydrocarbons. It is now shown that various other animal and vegetable oils behave similarly on heating anhydrous zinc chloride.—R. **Fosse**, Ph.

Hagène, and R. Dubois: Xanthyl compounds derived from amino acids.—Albert Michel-Lévy and Henri Termier: The Trapp rocks in the region of Raon-l'Etape (Vosges).—Etienne Patte: The isle of ashes, an Indo-Chinese volcano of recent appearance. This volcanic island was discovered in the process of formation by the Japanese ship *Wakasamaru* on March 2, 1923. The volcano was very active a fortnight later. By May 27, the area of the island had been reduced by about one-third, and the eruption had ceased.—F. Ehrmann and J. Savornin: Complement to the stratigraphic scale of the Kabylie des Babors, Algeria.—G. Pontier: The fossil elephants of England. The mutations of *Elephas antiquus* in the upper Pliocene and English Quarternary.—H. Colin and H. Belval: The soluble hydrocarbons of the wheat grain in the course of development.—A. Policard and G. Mangenot: The state of the oil in the reserve cell of the fatty seeds. The seed in germination.—E. Grynfeltt: The anatomical constitution and the signification of the pavilion of the uterine tube in woman.—Jules Amar: The phenomena of respiration. From a consideration of the total surface of the red blood corpuscles and the volume of oxygen consumed per minute, it is concluded that the hæmatic absorption is subordinate to the preliminary solution of the oxygen in the blood fluid. The true function of the red corpuscles is to increase, by their oxygen absorption, and to regularise, like a flywheel, the oxygen reserve of the higher animals.—R. Faillie and J. P. Langlois. The energy expenditure of the organism in walking down hill on an inclined plane.—R. Herpin: The swarming in full daylight of a *Pionosyllis lamelligera*.—Emile F. Terroine and H. Barthélémy. The composition of the organisms in the course of ovogenesis in the frog, *Rana fusca*. There is not a synthesis of fat at the expense of the tissues, but a transport to the ovary of fat previously accumulated in the organism. At the moment the eggs are delivered, the animal, without the ovaries, contains a very small proportion of fatty matter.—Ch. Dejean: The origin of the vitreous body and of the zonule.—O. Duboscq and P. Grassé: The small flagellæ of *Calotermes flavicollis*.—Etienne and Edmond Sergent and A. Catanei: Vaccination against paludism of birds obtained by the inoculation of a small number of living sporozoites.

MELBOURNE.

Royal Society of Victoria, June 7.—E. J. Hartung: The Mount Wilson solar observatory. A general account of the spectroheliograph and the establishment of the observatory on Mount Wilson was given. The solar tower telescopes, and the great reflectors for stellar and nebular work, were described and some of the lines of investigation which these instruments have rendered possible, were discussed. In conclusion reference was made to the projected Australian solar observatory on Mt. Stromlo, from which much may be expected.

June 14.—Mr. Wisewould, president, in the chair.—E. F. J. Love: Acceleration of gravity at the Melbourne Observatory. On taking Wright's determination into account, together with those utilised by the author in his previous paper, the value of g is increased, and the mean error diminished by 0·001 cm./sec.$^{-2}$. Reasons are given for regarding Wright's recent suggestion of variation in g with the time as unnecessary.—Sydney Pern: Different types of Australian boomerangs and their flight. The different types of war and return boomerangs, found amongst the various tribes were described, and also the methods of making the boomerangs, and how they were thrown. The author attributed the origin of the boomerang to the slow evolution of the throwing stick, which, when flattened and slightly twisted, was capable of greatly increased range. This stick took a slightly circular course, and by modifying it, a boomerang which would return was eventually developed. The different flights possible with the return boomerang were illustrated by wire models, and the method of throwing them to attain these different flights were explained. Four different ways of making the return boomerang were shown.

SYDNEY.

Linnean Society of New South Wales, April 18.—Mr. A. F. Basset Hull, president, in the chair.—W. F. Blakely: The Loranthaceæ of Australia, Pt. iv. A continuation of the systematic descriptions, eleven species and six varieties being dealt with, of which six species and five varieties are described as new.—H. I. Jensen: Some notes on the Permo-Carboniferous and overlying systems in Central Queensland. A summary of the results of geological reconnaissance work in the country lying between the Charleville Railway line and the Longreach Railway line in Western Queensland. Notes are given on the geological sequence in the Carnarvons and on the Bowen formations in the type district.—Vera Irwin-Smith: Studies in life-histories of Australian Diptera Brachycera. (i.) Stratiomyiidæ. No. 4. The respiratory system in larva, pupa and imago of *Metoponia rubriceps* Macquart. A contribution to the subject of the post-embryonic development and comparative morphology of the respiratory system in Diptera and in insects in general.

May 30.—Mr. A. F. Basset Hull, president, in the chair.—H. J. Carter: Revision of the genera Ethon, Cisseis, and their allies.—T. Harvey Johnston and G. H. Hardy: A revision of the Australian Diptera belonging to the genus Sarcophaga. This group of flies is of medical and veterinary interest. Eight names are placed as synonyms for the first time, one new species is described, one is given a new name, and one, which evidently has been imported from North America, is added to the list, making twenty-three species now known from Australia.—A. A. Lawson: The life-history of *Microcachrys tetragona* (Hook.). Practically a complete account of the gametophyte structures of one of the rarest and most interesting of the Australian Podocarpineæ.—J. McLuckie: Studies in symbiosis. iv. The root-nodules of *Casuarina Cunninghamiana* and their physiological significance.

Official Publications Received.

U.S. Department of Agriculture: Bureau of Biological Survey. North American Fauna, No. 46: A Biological Survey of the Pribilof Islands. Pp. vi+255. (Washington: Government Printing Office.)

Publikationer fra Det Danske Meteorologiske Institut Meddelelser. Nr. 5: Meteorological Problems. I. Travelling Cyclones. By V. H. Ryd. Pp. viii+124. (Kjobenhavn: G. E. C. Gad.)

South Australia: Department of Mines. Mining Review for the Half-year ended December 31, 1922. No. 37. Pp. 95+1 plate. (Adelaide: R. E. E. Rogers.)

Madras Agricultural Department. Year Book 1922. Pp. ii+84+5 charts. (Madras: Superintendent Government Press.)

Madras Agricultural Department. Bulletin No. 85: A Summary of the Results of the Experiments on Paddy conducted at the Manganallur Agricultural Station. By N. S. K. Pillai. Pp. v+35+12 charts. (Madras: Superintendent Government Press.) 1 rupee 14 annas.

Report on the Operations of the Department of Agriculture, Madras Presidency, for the Official Year 1921-22. Pp. ii+chart+29+5. (Madras: Superintendent Government Press.) 4 annas.