Editorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3451 SATURDAY, DECEMBER 21, 1935 Vol. 136

Scientific Humanism

IN the preface of his admirable volume on the history of seventeenth century science, Prof. A. Wolf pleads for a new orientation in humanistic studies. The need for such a re-orientation, repeatedly urged in the columns of NATURE, is becoming more evident daily. On the Continent, reasonable persuasion and confidence in public education are increasingly regarded as exploded liberal superstitions. Blind obedience to leaders with supposedly exceptional gifts is more in keeping with the temper of the times, and if we record with gratitude the fact that Britain and the Scandinavian countries are least swayed by it up to date, it is all the more important to forestall a danger against which we have been amply forewarned. Men of science in Huxley's generation urged the claims of education with an assurance which is rarely voiced to-day. If we ask why this is so, one reason is not far to seek. The old tradition which exacted several years of classical study as the price of scientific education had at least one advantage. At the end of it, scientific worker and statesman had a common realm of discourse. In modern practice there is a complete dichotomy between an education which gives the statesman no prescience of the technical forces shaping the society in which he lives, and one which stimulates in the scientific worker little interest in the social impact of his own activities.

That there exists substantial reason for dissatisfaction with the exploits of contemporary statesmanship most scientific workers realise, and far-sighted leaders of scientific work like Sir Frederick Gowland Hopkins and Sir John Orr already recognise how the work of the man of science must inevitably suffer if society fails to make use of it. Sir Josiah Stamp's recent assault on the technocrats, in his Norman Lockyer Lecture before the British Science Guild on "The Calculus of Plenty", emphasises the absence of a common vocabulary to make the reasons for alarm rationally articulate. For the economist as such, plenty has little meaning aside from making what use we do make of our present resources with what social machinery we take for granted. The plenty of the scientific worker is a thermodynamic reality which resides in the balance sheet of human effort expended in securing available sources of power which could be applied to the satisfaction of our common mammalian requirements, if their use were rationally planned. The economist takes it as an axiom that people choose different things and does not concern himself with the fact that they have many common needs. The man of science sees society as an association of individuals with many basic requirements ; and, since people have no instinct to recognise minimal quantities of ascorbic acid in their diet, he cannot assume that people necessarily choose what is best for them without a science of human nature to enlighten their choice.

The disruptive movements which have overwhelmed Germany and Italy have been, first and foremost, youth movements. Some explain this as a symptom of large-scale unemployment. In part it may be. Still, it is important to remember that, under existing conditions, it is nobody's business to take stock of what resources for human welfare are made available by progressive scientific knowledge. Consequently youth has some excuse for feeling that intelligent leadership in social affairs is not likely to come from present political parties. The existing curriculum of humanistic studies does little to arrest the retreat from reason Social history is a pageant of political controversy in which matters of sentiment play a larger part

than matters of fact, or a sequence of commercial enterprises solely controlled by the incentive of profit. What the expansion of maritime enterprise in the sixteenth century owed to rapid advances in nautical astronomy does not enter the picture. That witch-burning ceased almost as soon as the discovery that air has weight scattered the salamanders of alchemy, is shown to be more than a mere coincidence by the noteworthy experiment which Gassendi induced Colbert to witness. For purposes of history, as it is now taught, the general enlightenment of mankind proceeds with no acknowledgment of its debt to advancing knowledge of Nature.

At the end of the Great War, there was an articulate recognition of the danger of leaving the administration of a great country in the hands of civil servants trained in the tradition which prompted Mr. Gladstone's familiar query to Faraday. Pressure of informed opinion succeeded in securing a pivotal concession, when 'Everyday Science' was introduced as a compulsory subject in examinations for higher administrative posts of the Civil Service. The recent decision of the Commissioners to eliminate it will have deplorable consequences. Of late years there has been an encouraging sign of progress in the teaching of school science with more emphasis on its humanistic content. Many textbooks recently published show that more emphasis on the place of science in the education of the average citizen does not necessarily entail diffuse and vague courses of study conferring no knowledge which can be tested by customary examination standards. While the authors of such books deserve our gratitude, there is still ample scope for improvement, which will come, if teachers of science in the universities can be encouraged to co-operate with teachers of science in the school. In particular, there is need for more *extensive* as opposed to intensive teaching of isolated branches. With careful planning, and an enlightened social objective, this is not incompatible with examinable knowledge suitable for pupils of average intelligence.

The existence of the Civil Service examination in 'Everyday Science' acted as a catalyst. While it remained, it provided a unique opportunity for canalising the need for such co-operation by creating a demand for science courses in the universities suitable to students with a humanistic training. A beginning had been made under great difficulties with little appreciation from those who had been nurtured in the older tradition. If scientific men do not corporately influence the Commission to revise its decision, they will have forfeited an opportunity as well as a principle.

The Examination of Examinations

An Examination of Examinations: being a Summary of Investigations on the Comparison of Marks allotted to Examination Scripts by Independent Examiners and Boards of Examiners, together with a Section on a Viva Voce Examination. By Sir Philip Hartog and Dr. E. C. Rhodes. (International Institute Examinations Enquiry.) Pp. 81. (London: Macmillan and Co., Ltd., 1935.) 1*s*.

WHEN the late Prof. F. Y. Edgeworth made the startling discovery that twenty-eight experienced examiners could assign to the same piece of Latin prose marks varying from 45 to 100 per cent, he raised a doubt about the efficiency of public examinations which must have lingered ever since in the minds of persons concerned in their administration. No one questions that the major public examinations of Great Britain are conducted with scrupulous fairness, great pains being taken to secure by supervision and co-ordination of the examiners' work that the ultimate verdicts shall be as trustworthy as possible. The precautions worked out by Mr. David Mair when he was director of the Civil Service examinations are a noteworthy example of scientific efforts directed to this end; and the same thing may be said of the measures described by Dr. Crofts in his writings. Doubtless there are other authorities responsible for important examinations who approach the problems of administering them in the same scientific spirit; nevertheless, the results of inquiries which Prof. C. W. Valentine published in his book on the reliability of examinations showed only too clearly how doubtful an instrument for achieving its purpose an apparently well-administered examination may be.

The uneasiness stimulated by Prof. Valentine's book must be greatly increased by the pamphlet now written by Sir Philip Hartog and Dr. E. C.

Rhodes on behalf of the English Committee of the International Institute Examinations Enquiry. The committee, it should be understood, is a branch of a body enlisted under the auspices of the International Institute, Teachers College, Columbia University, and financed by the Carnegie Corporation and the Carnegie Foundation of New York. The object is an inquiry into the functions, methods of procedure and solid value of examinations in the more important countries of Europe and in the United States. The investigation is naturally taking different forms in the several countries, and in England has been devoted mainly, as the appearance of this pamphlet suggests, to "the examination of examinations" from the point of view of their efficiency. The chairman of the English committee is Sir Michael Sadler; Sir Philip Hartog is the director of the technical inquiries the committee has conducted, while Dr. Rhodes has served as the committee's statistical expert.

Several other publications have appeared or will appear under the authority of the Committee, but so far as the general public is concerned none is likely to excite so much interest as the present brief, cogent and admirably written memoir. It would be improper to regard it as an 'indictment' of our public examinations, if only because the inquiry it describes was facilitated, and indeed made possible, by the cordial co-operation of several important examination authorities, and by the willing collaboration of expert examiners who work for them. The validity of the results here set out depends, in short, largely upon the fact that the material investigated consisted entirely of scripts that had been written and assessed in connexion with some public examination of repute, and that the agents were experienced examiners working at a familiar task under conditions to which they are well accustomed.

These things premised, it must be admitted that the results of the inquiry establish beyond a doubt that chance plays a seriously large part in determining the verdicts passed upon candidates in examinations in which a student's career is very often determined by the kind of place he takes. One has always recognised the possibility that a question paper may or may not 'suit' a particular candidate. But what is now brought out is the degree to which the mark assigned by an examiner to a candidate's answers may depend not merely upon stable personal characteristics for which allowance could conceivably be made, but also upon tendencies which vary from time to time, and even upon such factors as his interest in the subject-matter of a particular question.

The examinations selected by the Committee for the purpose of the investigations were: (*a*) the 'school certificate' examinations taken in secondary schools by between 60,000 and 70,000 candidates every year; (*b*) the 'special place' examinations (taken by from 400,000 to 500,000 children annually, and of enormous social importance), by means of which children between the ages of ten and twelve years gain admittance from primary schools to central or secondary schools; (*c*) a college scholarship examination in English essay; (*d*) a university honours examination in mathematics; (*e*) a university honours examination in history.

Under heading (*a*) the plan adopted in investigating the marking of history and Latin was to select in one case 15 scripts, in the other case 15 couples of scripts, all of which had received the same 'middling' mark from the school certificate authorities concerned. In each case the scripts were re-marked in turn and independently by 15 examiners, who were asked to assign to them both numerical marks and also awards of failure, pass and credit. In the case of Latin the examiners were divided into two groups who, in accordance with their expressed preference, were guided in their detailed marking by schedules differing in a good many particulars, one of them containing a greater number of instructions to examiners than the other. As the outcome of this second examination, the fifteen history scripts originally considered to be of equal value received 43 different marks varying from 21 to 70 out of a maximum of 96. The fifteen couples of scripts in Latin received from the six examiners who worked under Scheme I, 24 different marks ranging from 28 to 55, and from their colleagues who used Scheme II, 28 marks ranging from 33 to 61. Even more striking, if not more significant, was the fact that when fourteen out of the original fifteen examiners marked the same fifteen history scripts after an interval of a year or more, not only did their numerical marks differ from those they had previously awarded (a difference of as many as 30 marks being made by one examiner), but the verdicts of failure, pass and credit were also varied in a very serious degree. On each occasion the examiners awarded a total of 210 verdicts to the fifteen candidates who had all originally received the same verdict (pass); and in 92 out of the 210 cases the verdict on the second occasion differed from the verdict delivered on the first.

The examinations of scripts in French and chemistry followed broadly the same lines with modifications, scripts of which the original marks corresponded to a normal frequency distribution being selected instead of scripts originally declared to be equal in value. In both subjects the same discrepancies in judgment on the part of the examiners came out. As a comparable investigation of school certificate English, the inquiry conducted on behalf of the Durham

University Examinations Board is quoted. It showed much the same discrepancies, the most serious from the point of view of the candidates being, once more, the lack of agreement among the examiners, not only about the mark deserved by a particular script but even about the verdict to be passed upon a candidate's performance. For example, out of 39 candidates awarded a failure mark by one or more examiners, 24 were awarded a credit, 8 special credit, and 3 distinction by one or more of their colleagues.

The scripts of 150 candidates in a 'special place' examination required more complex investigation, since they dealt with two subjects, English and arithmetic. The number made it possible for the committee to test divergent methods of marking; for example, the marking of English essays by general impression as distinguished from marking in accordance with a detailed schedule of items to be assessed. An unexpected result of these variations in method was the discovery—confirmed later when diverse methods of examining were applied in honours mathematics—that a detailed schedule, while it may bring about a certain degree of uniformity in the assessments of examiners, still leaves a dangerous amount of variation possible.

It is scarcely necessary to follow the Committee through its other investigations, the results of which confirm the conclusions already indicated. Another examination of a particularly interesting type must, however, be referred to: namely, the *viva voce* examination of 16 candidates of excellent academic standing, well recommended by their universities and attracted by a prize of £100. The object here was to make the examination conform as closely as possible with the *viva voce* examination of candidates for higher posts in the Home Civil Service, and the work was entrusted to two boards of distinguished and experienced men and women whose names are given. All 16 candidates were interviewed by the two boards. The members of each board were requested to assess independently upon a given scale a candidate's merits as revealed in the interview; and after interviewing him each board agreed upon a joint mark. While there was substantial agreement between the opinions of the members of the same board, the verdicts of the two boards differed in a quite remarkable degree. For example, the candidate who stood first in the estimation of Board I was placed thirteenth by Board II. As Sir Philip Hartog remarks, such glaring differences can only be accounted for by the luck of the interview. Board I happened to strike upon a subject which enabled the candidate to reveal his individuality, while Board II, although doing its utmost to explore the candidate's mind, did not happen to touch the revealing spring.

To the major section of the report which describes the investigations and their results is appended a briefer section dealing with the statistical aspect of the inquiry. Its purpose is to show how, from the verdicts given on a number of scripts by a number of examiners, one could determine: (*a*) the ideal mark which 'ought' to have been given to a script; and (*b*) a measure of the random variations in assessment to which a particular examiner is liable. The assumption made is that the mark actually given in a particular case differs from the ideal by a fixed amount characteristic of the examiner's general habit of marking, *plus* an independently varying amount dependent upon a characteristic distribution of random variations about his standard. A reassuring footnote on page 44 mentions a further difference between examiners: namely, a difference in the spread or standard deviation of the marks they would give in a particular examination even if their random variations could be eliminated. It is stated that the influence of these further differences has been estimated, and as far as the examinations considered in the pamphlet are concerned, has been found to be relatively slight. This conclusion may be true of examinations such as those for the school certificate, where definite levels of achievement with definite marks connected with them are familiar to the examiners. The reviewer's experience of one of the largest 'special place' examinations has, however, led him to attach much greater importance than the authors think should be given to differences in the standard deviations of examiners' marks. Setting this point aside, all that need be added is that it is shown how the standard deviation of each examiner's random marks can be calculated. It is then possible, on the principle that an examiner's 'weight' is inversely proportional to his liability to random variations, to obtain a simple ratio from which the ideal mark can be calculated.

It must not, however, be supposed that the method of calculation, interesting as it is, can be used to remove from the marks given in public examinations the serious element of doubt they at present contain; for it depends upon the assumption that a considerable number of examiners have marked each script independently under carefully prescribed rules, and that is a condition which no examining authority could afford to incorporate into its procedure.

The future publications announced by the committee include a treatise on the "Marks of Examiners" by the present authors, which will also contain a memorandum by Prof. Cyril Burt. Serious students of the subject will look forward to this work, which will presumably develop a good deal further the technical methods to which

reference has just been made. But it is not necessary to wait for the further publication before expressing the opinion that the Committee, by the well-conceived and carefully conducted researches described in this memoir, and Sir Philip Hartog and Dr. Rhodes by their lucid account of them, have conferred a very definite obligation upon the public.

The public may, however, ask—and not unreasonably—how the Committee would deal with the disquieting things which the inquiry has revealed. Would it end examinations, or mend them? And if it would mend them, then in what way? The Committee does not entirely ignore these questions, but it has not gone into them. It points out that the "new type" examinations are by their nature entirely free from the weaknesses of the ordinary type; nevertheless, it cannot bring itself to contemplate the abolition of the essay type of answer, which is the kind normally demanded of candidates in public examinations. If the latter attitude prevails—and it is supported in Great Britain by an enormous weight of tradition and prejudice—the problem of retaining the present mode of examinations while making them reliable assumes very great importance. In view of its difficulty—perhaps its final insolubility—it would seem desirable to explore simultaneously alternative methods of assessing progress and knowledge at least for pupils at school. Attention should therefore, we think, be given to carefully standardised methods of recording progress such as those now used by some of the county authorities in their primary schools and described in the 1935 issue of the "Year-Book of Education".

Dreams and Culture

The Dream in Primitive Cultures

By Dr. Jackson Steward Lincoln. Pp. xiii+359. (London: The Cresset Press, Ltd., 1935.) 18*s*. net.

AMONG primitive and superstitious people throughout the world, dreams have nearly always been estimated highly. It was perhaps inevitable that western science, in its endeavour to eschew fantasy and concentrate on verifiable fact, should have reversed the verdict and regarded the unruly figments of our sleeping minds with ill-disguised contempt. Nevertheless, the mere occurrence of dreaming remained a challenge to the psychologist, while the high value placed on dreams by primitives is in turn a fact which can be neglected by the anthropologist only at his own peril. It is true that Tylor had already attributed a very important role to dreams in his doctrine of animism. Nevertheless, the rehabilitation of dreams by Freud should have implied as a practical corollary a thorough reconsideration, in the light of new knowledge afforded by psycho-analysis, of the influence of dreams on primitive culture, and it is perhaps indicative of the over-departmentalisation of the human sciences that it is only now, thirty-five years after the publication of the "Traumdeutung", that there has appeared a serious attempt at a general treatment of this subject.

It has often been noticed that the savage, like the child, appears to distinguish less easily than we do between dream events and events in waking life. This apparent confusion is due, Dr. Lincoln argues in this book, not so much to a real inability to separate the two types of experience, but rather to the fact that dream experiences are given an equal, or even a higher, reality value; and are not, as with ourselves, considered to be meaningless or negligible. Thus, to take an example quoted from Raymond Firth, an Indian dreamt that W. B. Grubb had stolen things from his garden and after waking demanded that he should make amends. Argument showed that the dreamer realised that Grubb had not been there in person. Nevertheless, he maintained, "If you had been there, you would have taken them". Here (in virtue of the psychological mechanism of projection) "the dream is given reality value at the expense of actual experience, yet there is no confusion between the two kinds of experience" (p. 29).

Furthermore, there would seem to be two distinguishable attitudes towards dreams among primitive peoples. In some cultures, as among the extinct Huron and the Navajo, the manifest content is taken at its face value, while in others, as among the Ashanti and the Naga, there is a search for latent symbolic meanings which, when found, enable the dream to be interpreted. To judge from the examples given, however, some degree of interpretation at least seems to be very general.

Perhaps the most important distinction made in the book is that between unsought, spontaneous, individual, dreams on one hand, and induced, 'traditional', 'culture pattern' dreams upon the other. The system of seeking guidance in dreams induced by some special ritual is very widespread. Temple incubation was fashionable in classical times, while in existing or recent cultures procedures for inducing dreams are found in Australia,

Melanesia, Polynesia, Africa and, above all, in North America, where the author's own field work was carried out. Here, as among the Crow Indians, the vision quest may even be "the most important social event in tribal life". Many examples, both from Dr. Lincoln's own extensive collection and from the records of other workers, show the paramount influence of these sought dreams upon the whole subsequent life of the dreamer. They may dictate his name, his profession (especially if he is to be considered as endowed with magical or healing powers), his guardian spirit, his courtship, his prayers and sacrifices, his treatment in mental or physical disease, or even in a social sense his sex, for certain dreams may compel a man to adopt the clothes and duties of a woman.

Not only the life of the individual but also that of a whole society may be profoundly affected by dreams, sought or unsought: war, myths, traditional dances, totems, religious ceremonies and migrations, being sometimes thus determined.

So important is the right dream vision that dreams may sometimes be purchased, though often this process is considered as dangerous to the vendor and therefore tends to be concealed. A stickler for accuracy of psychological description might suggest that this tendency to concealment renders it probable that actual individual dreams of a culture pattern kind are rarer than is commonly asserted. This, however, makes little difference to the sociological importance of the dream in general.

In most induced dreams of cultural importance, the new item of culture is nearly always prescribed by a spirit figure, which, Dr. Lincoln maintains, can be regarded as a father-imago in the psycho-analytic sense—and this irrespective of whether the dreamer belongs to a patrilineal or matrilineal society. Evidence is presented to show that the prescribed item represents an attempt to surmount the difficulties of the Oedipus complex, which thus, as psycho-analysts have already maintained from a different angle, is a very potent factor in moulding culture generally. This suggestion opens up an interesting problem (not here dealt with) as to the relation between culture pattern dreams and initiation ceremonies, in which culture items are definitely handed down by direct instruction from the elders.

Furthermore, it is maintained that the widespread occurrence of dreams of this description shows the ever-present nature of the Oedipus complex, which appears to recur spontaneously in each succeeding generation. If this is so, we can accept Freud's explanation of many cultural institutions without "fruitless speculations as to first origins" or the assumption of innate ideas or racial memories.

Dr. Lincoln's book (which contains a preface by Prof. C. G. Seligman) undoubtedly deserves careful consideration by students of both anthropology and psychology, and is a happy example of fruitful fusion of these two disciplines.

The Boundaries of the Sciences

(1) A Comprehensive Treatise on Engineering Geology

By Dr. Cyril S. Fox. Pp. xv+392+18 plates. (London: The Technical Press, Ltd., 1935.) 35*s*. net.

(2) Géologie appliquée

Par Prof. E. Raguin. Pp. 403. (Paris: Masson et Cie, 1934.) 38 francs.

(3) Useful Aspects of Geology:

an Introduction to Geological Science for Engineers, Mining Men, Prospectors and all interested in the Mineral Industries. By Dr. S. J. Shand. Second edition, revised and amplified. Pp. x+183. (London: Thomas Murby and Co., 1934.) 6*s*. net.

WATERTIGHT compartments are obsolescent in modern scientific thought, so that an increasing number of partnerships are found as in biochemistry, biophysics, the use of X-rays in medicine, crystal structure and industry, and the application of physical chemistry to road and building problems. The dangers of the over-specialisation of the scientific worker, so often debated and deplored in the columns of NATURE, have been much to the fore in recent years; and the reviewer well remembers a remark made in his student days by the then Provost of University College, London, to a gathering of undergraduates, in which it was pointed out that the difficulties experienced by graduates in finding employment was largely caused by the fact that they had specialised in one branch of science only.

The applied science known under the broad term of engineering has suffered less from this disability than many of the pure sciences such as geology, which apart from its application to mining is still regarded by many as an excellent hobby study, but as otherwise of limited practical application. Chemistry has extended enormously into almost all branches of industry, physics is rapidly following suit, while botany and zoology

are also finding applications in agricultural, horticultural, animal and fishery problems.

There are, however, signs that geology is beginning to realise its potential value for the civil engineer and roadmaker; and though much work both of an educational and of a research character still remains to be done before its application can be said to have been thoroughly explored, the small but persistent stream of scientific works is encouraging.

(1) The extremely readable treatise by Dr. Cyril Fox opens with theoretical considerations on such matters as the solar system and the age of the earth; and these topics, from their purely scientific interest, might have been abbreviated or omitted with advantage, while the next chapter, which deals with the common rock-forming minerals, contains matter irrelevant to the main theme. It is thought that a series of carefully selected photomicrographs, on the lines of those given by H. G. Smith in "Minerals and the Microscope", accompanied by really full descriptions, would enhance greatly the value of the work. The physical characters of rocks and minerals, as affecting their industrial and commercial uses, have been the subject of research in Germany, the United States and Great Britain during the past twenty years, but the treatise takes little account of any such developments published since 1925, and the usefulness of Part 1 (Building Materials) is curtailed accordingly.

The full treatment accorded to such subjects as isostasy and earthquakes is doubtless due to the experiences of the author in so unstable a region of the earth's crust as the Himalayas, and forms the basis of much of Part 2 (Field Operations); and almost the only valid criticism of this portion is in respect of the omission of any reference to recent studies by civil engineers of the behaviour of shingle beaches as agents of coast erosion. Part 3 deals with water supply, and it may be questioned whether an engineer requiring information on the quality of water would make reference to a work of this kind, which omits to discuss recent work such as chlorination of drinking water obtained from rivers, while yet dealing with the general considerations affecting rainfall and the movements of terrestrial waters in an orthodox but attractive manner.

The question of the matter to be included in or excluded from such a treatise must always be difficult, and the points mentioned above do not detract seriously from its value for any but the specialist reader. Such spelling errors as occur are probably due to difficulties of proof reading as between an author resident in India and his publisher in London; the style and method of publication are excellent.

(2) M. Raguin covers an even wider field, his first four chapters dealing with the evolution of the surface features of the earth, the mode of formation of solid rocks, the sequence of geological events and the nature of tectonic movements, while the succeeding nine chapters embrace such diverse matters as a brief outline of stratigraphical geology, materials of construction, the building of tunnels and barrages, the movement of underground waters, the combustible minerals such as coal and oil, the study of mineral veins and geophysical methods applied to prospecting.

Here again a readable style is combined with a series of very clear and evidently carefully prepared diagrams, the chapter on stratigraphical geology being interleaved with a series of photographs of common fossils characteristic of the various geological systems. One would perhaps have preferred to have seen a curtailment of this latter treatment, together with an expansion of the portions dealing with mineralogy and petrology, as likely to be of greater use to the majority of readers. The geological bias of the book is more apparent than in that by Dr. Fox, while the space accorded to such matters as overthrusting, klippen-structures and nappes, with all their complications, is only to be expected, having regard to the natural interest of French geologists in Alpine tectonics.

It is stated in the preface that the work is not intended for the specialist, but in spite of this proviso, it should prove of interest to many specialists requiring information on branches of the subject which are cognate to their own.

(3) As a purely introductory type of book, that by Prof. Shand is a most helpful work. It is many years since the elements of geological science have been set out in a manner so calculated to catch and to hold the interest of the non-technical reader. It is well known that one of the chief difficulties in this connexion is the avoidance of the use of scientific terms which are unfamiliar to the beginner, and Prof. Shand has succeeded admirably in his difficult task in this little volume. It is certain that geologists in Great Britain, often notoriously backward in attempting to popularise or to apply their science to the needs of the common man, will find it extremely difficult to cover so many really useful aspects of geology in so lucid a manner.

Emphasis is laid rightly on the importance of field and laboratory studies, and it would be an invidious task to point out minor omissions in a work covering so wide a field. It is to be hoped that the popular view of geology as a dry-as-dust subject will be still further dispelled by the appearance and wide use of still more books of the kinds noted above.

B. H. KNIGHT.

Practical Quantum Mechanics

Introduction to Quantum Mechanics: with Applications to Chemistry
By Prof. Linus Pauling and Dr. E. Bright Wilson, Jr. Pp. xiii+468. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 30*s*. net.

QUITE a number of books have been written on quantum mechanics with applications to problems of physics. Now, however, we have something new, a book on quantum mechanics with applications to chemistry. It is a field which for some time has needed ploughing; and the names of the authors guarantee that the job has been well done.

The logical development of the book is extremely good. After the usual introduction and decline and fall of the old quantum theory, it proceeds to show how the Schrödinger equation can be set up for a system of interacting particles. The rigorous solutions for the harmonic oscillator, the hydrogen atom, and the particle in the box are then worked out in considerable detail. By this time the reader is well prepared for solutions by approximations; and perturbation theory and variation methods follow quite naturally. So far, only one-electron systems have been discussed, and as an introduction to many-electron systems a whole chapter is devoted to the helium atom, mainly with the view of accustoming the reader to spin, Pauli principle and all the other jargon of atomic and molecular structure. The discussion of atoms is rounded off with a difficult chapter on Slater's theory of complex spectra and Hartree's method of the self-consistent field.

About half the book has now been covered. The remainder deals chiefly with molecules, beginning with the rotations and vibrations of diatomic and polyatomic molecules, together with a short account of the selection rules. Then comes a section on calculations of the energy of formation of molecules. Simplest is the hydrogen molecular ion, and next the hydrogen molecule. This section ends with a brief description of Slater's treatment of polyatomic molecules and a few pages on 'resonance'.

At this point the authors, seeing that they are far from home in spite of nearly 400 pages, decide that the pace must be quickened. They select four applications of quantum mechanics to miscellaneous problems and write a few cogent pages on each, bundling them together to make the penultimate chapter. The last chapter is on the same plan, but takes as its subject matter some of the more important methods and principles of general theory. There is an appendix which includes many useful facts, such as physical constants and normalising factors, and this concludes with a fitting tribute to the Greeks in the form of the Greek alphabet!

The book is primarily an introduction to quantum mechanics, and as such necessarily contains a fair amount of material already available elsewhere. For example, the theory of the harmonic oscillator and of the hydrogen atom have already been given in many other places. Perhaps for this very reason they are now dealt with at unusual length. Numerous diagrams are given of the wave functions, and with their help the reader should readily grasp the significance of what might otherwise have remained merely a mathematical formula.

The book is highly recommended as a textbook of practical quantum mechanics. It is well balanced and very readable; the diagrams are workmanlike and the index good. Each chapter includes about half a dozen problems, and many suggestions are made for further reading. Unfortunately the book, like many others from the United States, is rather expensive. W. G. P.

Physics for College Students:
an Introduction to the Study of the Physical Sciences. By Prof. A. A. Knowlton. Second edition. Pp. xxi+623. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 21*s*. net.

THE author is to be congratulated on the production of an original and stimulating work which amply justifies the study of physics as a cultural subject. The treatment is based on the doctrine of energy, and, while it is quite elementary, making very little appeal to mathematics, it is closely reasoned, alive and in touch with reality, and calculated to keep the reader's mind constantly on the stretch. The fifty-seven chapters into which the book is divided cover very thoroughly the whole field of elementary physics, and at every step of his progress the reader may test his knowledge by means of well-selected quantitative examples and ingeniously devised topics for discussion.

A notable addition to the elementary literature of the subject. A. F.

Aufbau der zusammenhängenden Materie

Redigiert von A. Smekal. Pp. xiv+1203. ("Handbuch der Physik". Herausgegeben von H. Geiger und Karl Scheel. Zweite Auflage. Bd. 24, Teil 2.) (Berlin: Julius Springer, 1933.) 129 gold marks.

ONE hundred and twenty-nine gold marks may seem a very stiff price to pay for a scientific book even when advantage may be taken of the new facilities for purchasing German books at 25 per cent discount, but the present volume is exceptional in many ways. It contains some 1200 pages of excellently printed matter, and the subjects treated are such that it could not well have been inexpensively produced. It is well supplied with tables and diagrams, and little or no attempt has been made to save expense by undue curtailment of the mathematical treatment. One may legitimately look at the six chapters and ask oneself, in considering the cost, how much one would expect to pay for the excellent 300 page treatise on the electron theory of metals by Sommerfeld and Bethe, if it were issued in separate covers; or, again, what would be the market price of a book of 200 pages on atomic structure and chemistry, by Grimm and Wolff.

The plan followed is very satisfactory. Herzfeld writes on the size and structure of molecules, considers their electric properties, their band spectra and the forces between them in the various states of aggregation. Perhaps one may say that English readers will be surprised that he does not devote more space to viscosity formulæ in his comprehensive survey. Kronig deals with the relations between molecular attractions and the structure of crystals, and includes a neat account of the significance of the fine structure observed in the edges of X-ray absorption bands. Then follows the compact treatment of the electron theory of metals given by Sommerfeld and Bethe; it is doubtful whether some of the properties of metals here discussed have previously been described in so clear and concise a manner. The problems of the crystal lattice are examined by Born and Göppert-Mayer, Smekal deals with the factors which influence the properties of crystals, and the article by Grimm and Wolff completes the book.

It is an important contribution to the literature of modern physics and chemistry, and a work which will frequently be consulted by most research workers interested in modern theory. From this point of view it is a pity that the book is not issued in two or more separate parts. L. F. B.

Leçons d'algèbre et de géométrie à l'usage des étudiants des Facultés des Sciences

Par Prof. René Garnier. D'Après la rédaction de Badrig Guèndjian. Tome 1: Algèbre linéaire, homographie, équations tangentielles. Pp. viii+233. (Cours de la Faculté des Sciences de Paris.) (Paris: Gauthier-Villars, 1935.) 40 francs.

THIS book has been specially written by Prof. Garnier for mathematical students taking a course in the faculty of science at Paris. It is essentially a theoretical treatise embracing four chapters on linear algebra; two on the classic theorems of both plane and solid projective geometry and one on tangential equations. The treatment is wholly analytical and, as the author points out in the preface, the most general methods have been applied in establishing the fundamental propositions. Centres and diameters of conics, for example, are derived as special cases of poles and polars.

The text has been very clearly written, and it is difficult to discriminate between the excellence of the various chapters. Special mention, however, should be made of the brilliant analytical discussions on enharmonic ratios and envelopes. These, in spite of their generality, should not fail to stimulate a keen interest in the reader. If the book has a defect at all, it is that common to most French textbooks, for there are no exercises provided for the student's practice.

Toxikologische Mikroanalyse:

Qualitative Mikrochemie der Gifte u.a. gerichtlich-chemisch wichtiger Stoffe. Von Prof. Dr. L. Rosenthaler. Pp. viii+368. (Berlin: Gebrüder Borntraeger, 1935.) 25.50 gold marks.

THIS work may be regarded to a large extent as complementary to Dr. Rosenthaler's "Der Nachweis organischer Verbindungen" (Stuttgart, 1923), in which he treats of macro-analytical methods in organic chemistry. In the new volume he gives a comprehensive and reliable account of the many micro-methods which are now available for the detection of poisons, whether in traces or otherwise. As he points out, forensic chemistry offers a particularly favourable field for the application of micro-analytical methods.

The book gives a short general account (19 pp.) of micro-methods for sublimation, distillation, electro-analysis, spectro-analysis, crystallisation, etc., followed by descriptions of diagnostic tests for specific inorganic (76 pp.) and organic (259 pp.) substances.

The book is well printed, and there are numerous illustrations, chiefly of crystalline derivatives prepared in the various tests; it should prove of use to practical workers in forensic medicine and analytical chemistry in general. J. R.

Value and Existence

By Prof. N. O. Lossky and Prof. John S. Marshall, Pp. 223. (London: George Allen and Unwin, Ltd., 1935.) 7*s*. 6*d*. net.

AT a time when materialism appears to be at a discount, it is natural that discussions on the problem of values become more and more pressing. To such discussions, Prof. Lossky contributes an excellent monograph in which the notions of value and existence are interpreted in terms of a Neo-Platonism tempered by Christian ideals. Where true absolute concrete consubstantiality lies and how it is related to this world, are the two aspects of the problem dealt with in part 1 of the book. In the second part, which is contributed by Prof. Marshall, we find an explanation of some basic conceptions of Prof. Lossky's views. T. G.

The Phenomena of Spin in Detonation

CAMPBELL and Woodhead[1] discovered that in certain gaseous mixtures, when a detonating type of combustion flashed along a cylindrical tube, the flame front was not simply a disc-like or convex surface, but the detonation spun spiralwise along the tube, giving rise to a banded appearance in the photographs of the luminous products of combustion. Bone and Fraser[2] made a careful photographic investigation of the phenomenon, which showed that the initiation of detonation was almost

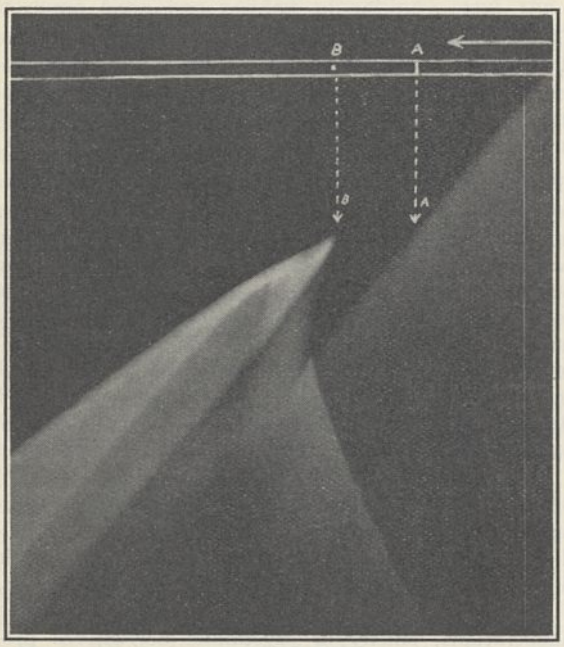


FIG. 1.

invariably associated with the spin of the 'head' of detonation but that in hydrogen mixtures it rapidly disappeared, whereas in certain mixtures it was visible in the ordinary flame before the detonating condition had been reached. They came to the conclusion that the frequency of the spin was fairly independent of the composition of the mixture, of its density and of the speed with which the detonation passed down the tube, but that it depended on the tube diameter such that the pitch of the rotation of the 'head' was about three times the tube diameter. Those results were obtained using a 9 in. duralumin drum rotating at 16,000 r.p.m. (equivalent to a film speed of 190 m./sec.). The extension of that investigation[3], which will be briefly described in this article, has been rendered possible by the use of a special camera whereby photographs could be taken at speeds which would be equivalent to using a film rotating on a drum at 1,000 metres a second, thus enabling events to be recorded which happen during a millionth of a second.

The apparatus consists essentially of a double-sided stainless steel mirror which is rotated at high speed, and flashes the image of the explosion formed by a suitable lens (Dallmeyer Pentac 12 in. focus) on to the surface of a circularly disposed stationary photographic film. In order to rotate the mirror at the high speed (30,000 r.p.m.), which is equivalent to a speed of rotation of the image of 1,000 per sec., the mounting has to be such that a vacuum can be maintained within the camera. The drive is by means of a 4 h.p. motor which can be maintained at any constant speed up to 6,000 r.p.m. by an auxiliary dynamo, the voltage output of which is controlled by altering the resistance in the shunt-field circuit; this, together with the friction drive off a spherical steel surface which is rotated by the motor, enables the most suitable speed to be chosen so as to provide the most accurate measurement of the flame. The explosive mixture is usually fired by a spark and travels down a 7 metre length of copper tube and then through a special tap into a glass tube 1·3 cm. diameter and $1\frac{1}{2}$ metres long which is placed in the field of view of the camera lens. Most of the experiments were made with $2CO + O_2$ mixtures.

It is only possible here to mention a few of the results of the investigation; the photographs provide detail of the phenomena of detonation never before attained. It has often been noticed[4], when the detonating type of combustion is initiated, that where this initiation occurs is somewhat ahead of the advancing flame front. The present investigation shows quite definitely that this is generally the case. The composite character of the setting up of the detonation is clearly shown in Fig. 1. The flame travels forward at 1,275 m./sec.; it so influences the combustible molecules in a compression wave ahead that ignition suddenly occurs at *B*, 6·3 cm. from the flame, which has reached position *A*, and from the position *B* a detonation wave travels forward at 3,260 m./sec. The velocity of this wave soon subsides, however, to 1,980 m./sec. A wave also starts in the backward direction from the seat of detonation through the gases with a resultant forward velocity of 350 m./sec., and gives rise on meeting the advancing flame to the 'retonation' wave travelling back through the products at 875 m./sec. Not only

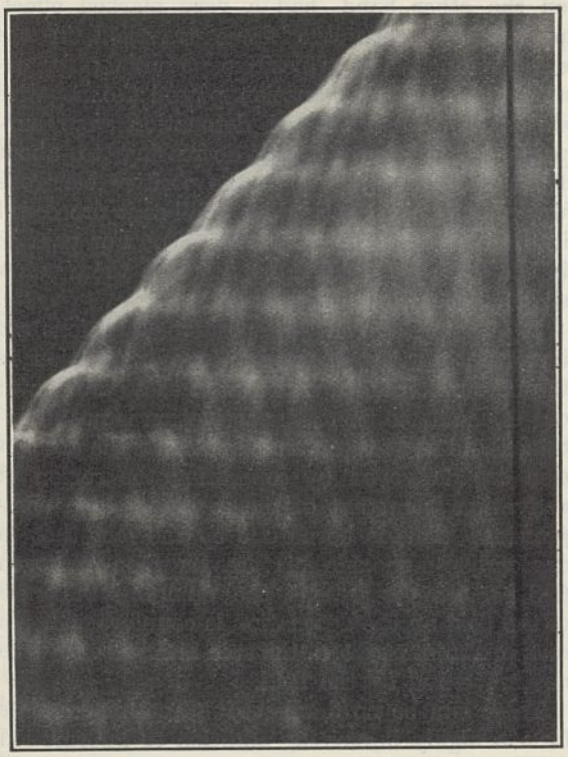


FIG. 2.

is a compression wave visible which travels out from the point of auto-ignition at 1,320 m./sec., but also, at the point where the initial rapid detonation in the forward direction subsides to the more normal velocity, a compression wave is visible which moves forward, also at 1,320 m./sec. The spin first makes its appearance at this point. The whole interval from the point when auto-ignition occurs to the point when the velocity subsides to 1,980 m./sec. is only about a ten thousandth of a second.

The spin is due to the spiral motion of the head of detonation down the tube, and the pitch appears to be governed mainly by the diameter of the tube, as was shown by causing a detonation to proceed down a tapered tube. It is possible to observe the phenomenon of spin and to maintain detonation in $2CO + O_2$ mixtures in tubes so small as 3·6 mm. diameter. In tubes of triangular or square section the pitch of the spin is nearly that which would occur in a tube of circular section of equal periphery; in a tube of oblong section the track is that in a tube of circular section the periphery of which corresponds to the shorter sides of the oblong.

The banded appearance of the after-flame which was obtained in former investigations is now shown by the higher resolution to be due to the criss-crossing of a set of waves or regions of high luminosity starting out from the spinning head twice during each rotation and proceeding at an angle of 22° to each other, one in the forward direction and the other slightly retrogressive (see Fig. 2).

The authors state that "whether or not a persistent spin develops in a detonation seems to depend on the requisite degree of excitation of the combustible gas. In cases (such as when hydrogen is involved) where this is easily attained, the initial close association between the forward moving compression wave and the burning medium in the front does not become attenuated and no persistent spin can be developed. On the other hand, a persistent spin develops whenever the requisite degree of excitation of the molecules of the combustible gas is such as to render the association between the forward moving front precarious so that an attenuated (cone-shaped) front develops". They also state that "it follows geometrically that at each half-rotation of the head a pocket of the unburnt gas will be enclosed on

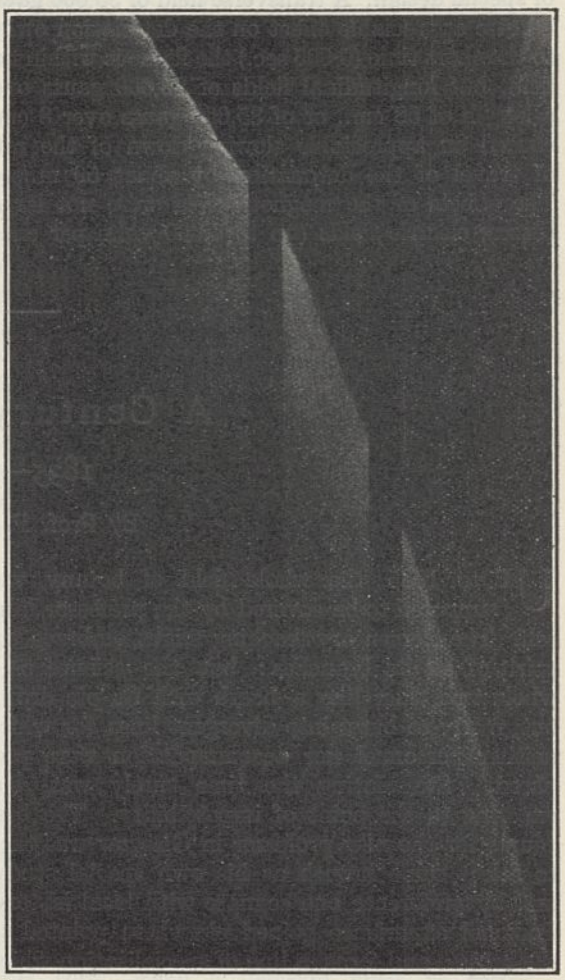


FIG. 3.

three sides by the flame and thereby spontaneously ignited by its radiation", giving rise to the effects observed which accompany the spin.

The view that activated combustion must be associated with the compression wave in order to maintain detonation is supported by experiments in which a small $\frac{1}{4}$-in. nitrogen gap (obtained by means of the special tap) in the column of explosive gas causes the detonation and spin to be destroyed and only reinitiated when the flame front again catches up the compression wave. It is interesting to learn that, contrary to Dixon's results, the velocity and stability of the detonation wave is enhanced rather than diminished by intensively drying the carbon monoxide mixtures. Addition of hydrogen appears to give rise to a multiplicity of spinning heads, and more than 2 per cent of hydrogen tends to prevent the spin, though detonation is maintained.

The remainder of the present memoir relates to experiments on the effect of magnetic and electric fields on the propagation of detonation. Very strong magnetic fields were obtained by magnets of special design. A transverse field of 35,000 gauss had no appreciable effect on the detonation owing to the short time (0·005 sec.) the flame is within the field, but longitudinal fields of 22,000 gauss over a length of 58 cm., or of 35,000 gauss over 8 cm., caused an appreciable slowing down of the rate of travel of the detonation by about 50 m./sec. The effects of the magnetic field were not large. Strong electric fields (up to 5,000 volts per cm.), on the other hand, had a very marked effect, particularly when the flame travelled in the direction negative to positive potential; for example, when the detonation passed the negative electrode, both spin and detonation were suppressed, the flame speed decreasing to about 1,000 m./sec. by the time the positive electrode was reached and continuing to fall as it proceeded into the no-field region (see Fig. 3). For passage in the direction positive to negative there was a slight acceleration of the flame.

It is supposed that the positive CO^+ ions are important for the maintenance of activation in the detonation head, and that if these are drawn out of the flame front, the activation is not maintained and so the spin and eventually the detonation are destroyed by separating the region of activation from that of the region of high compression. This is borne out by the fact that in dry carbon monoxide mixtures or when hydrogen (0·3 per cent) is present, the 'damping' influence of the field on the detonation is counteracted. In methane mixtures, too, the spin and velocity were not influenced by the field.

There can be no doubt that these experiments form a highly interesting addition to information about the behaviour of the detonating type of explosive in gaseous mixtures. A. C. E.

[1] *J. Chem. Soc.*, 3010; 1926.
[2] *Phil. Trans.*, A, **230**, 363; 1932.
[3] Bone, Fraser and Wheeler, *Phil. Trans.*, *A*, **235**, 29; 1935.
[4] Le Chatelier, *C.R.*, **130**, 1756; 1900. Egerton and Gates, *Proc. Roy. Soc.*, *A*, **114**, 137; 1927. Bone and Fraser, loc. cit.

A Century of Botany*

1835—1885—1935

By Prof. F. O. Bower, F.R.S.

UP to 1885, the whole field of botany was supposed to be covered by the professor himself. The elementary teaching might embrace the spirit of all its branches: but the science as a whole was then like a bomb with its pin drawn out, ready to burst into divergent lines for which neither personnel nor accommodation were prepared. Stimulating the time surely was, but exacting to the point of impossibility. The best course for the new professor in Glasgow was then to select some branch as his own special study, and by preference one cognate with local history. Personal experience gained elsewhere pointed to the mosses and ferns, a line of specialisation which would renew continuity with the Hookerian tradition. Moreover, the overcast skies of Glasgow gave conditions suitable for their culture. So after an interval of half a century, the special line of research followed there by Sir William Hooker was resumed.

With the new ordinances framed under the Act of 1889 came changes of organisation, which had the effect of levelling up the Scottish university system to that of England. The establishment of degrees in science stimulated higher courses in all the departments, and this led, of necessity, to their expansion both in staff and in equipment. Under the new ordinances, the differentiation of elementary and advanced classes involved an

* *Continued from p.* 941.

increased staff. The appointment of additional lecturers and assistants stimulated research, for which space was now available.

A group of botanical investigators was thus formed, who not only pursued the special study of the living Archegoniatæ, but also extended their comparisons to the cognate fossils. The co-operation of Lang and Gwynne-Vaughan with myself established that 'triumvirate', who worked happily and fruitfully together for twelve years. In close relation with us that remarkable palæo-phytologist, the late Dr. Robert Kidston, a prince of amateurs, was also associated. With his aid new problems of comparison between past and present vegetation were opened. As results it may suffice to quote the series of memoirs by Kidston and Gwynne-Vaughan on the fossil Osmundaceæ, and those by Kidston and Lang on the fossils of the Rhynie Chert, carried out after Dr. Lang had moved to Manchester. These show the value of the co-operation between Dr. Kidston's house at Stirling and the Glasgow Department. Happily, under his will all the type specimens of these classic works, together with others of untold value, are now in safe keeping in the Department. Thus Glasgow became once more a centre for study of the Archegoniatæ. A ready channel of publication was offered by the Royal Society of Edinburgh. Its resources, with financial aid from the Carnegie Trust, have made a stream of published work available from the Glasgow Department which, in scientific value and beauty of production, will bear comparison with any produced elsewhere.

Passing now to the present time, we may ask how botanical organisation in 1935 strikes one who can compare it by personal contact with that of the previous century. As we have seen, up to 1885 each aspirant to a chair in botany was assumed to possess a general knowledge of and sympathy with all branches of his subject. These were themselves less differentiated than now, and some scarcely distinguishable unless as parts of a compact whole. Segregation followed quickly on the revival of the 'seventies and 'eighties. I well remember Sir Joseph Hooker saying ruefully to me in the early 'eighties, "You young men do not know your plants". That was at the time when systematic botany was beginning to lose its hold as the main staple in Britain. His judgment was true: we did not know them in the Hookerian sense.

A counterpart to Hooker's plaint may be found in the ironic hyperbole of a distinguished physiologist, who is reported to have said at a later date, "I suppose I do know half a dozen species of the British flora". These illustrations suggest the inevitable effect of that fission of a science which is apt to follow upon its detailed study. Hence as the years went on the position of the head of a botanical department, so often single-handed, became increasingly difficult. If he attempted to keep abreast of all branches he would become, like a medieval knight, overweighted by his armour of facts and theories, and ever less able to keep his place in the front line of research. Extinction as an effective unit would loom large.

From 1885 onwards there has been an increasing desire among young investigators to publish their results early. This offers promotion as its reward: for a published output of detailed research commonly weighs more with a selection committee than general knowledge, or the ability to administer and to teach. A premium is thus placed upon early specialisation, and the young aspirant is in danger of developing "like an ill-roasted egg, all on one side". Some great departments already have special sub-departments of pomology, of citrus fruits, or of bananas, to which specialists severally devote their lives. Among these various cults we may well ask, where do the major departments of morphology, physiology and classification come in? Doubtless each of the minor branches is in touch more or less directly with one or more of these foundations of the organised whole. But each may be pursued without any realisation of what that whole actually is.

A necessary corrective will be an avoidance of too early specialisation, and the cultivation of the type of mind that strikes a fair balance between the fundamental branches. This is indispensable above all for the administrative head, who is responsible for maintaining a balance between the various branches in the organisation of his department. There is no difficulty in finding among young graduates those able to carry out special inquiries of detail. What will be required more and more urgently as time goes on is the synthetic mind, that ranges over a wide field with adequate command of detail, and is able to compare, evaluate and deduce. This is essential for the all-round botanist, that less common type from which comes the successful head of a department. Risks of development await both types. The former may continue his analysis and never advance beyond providing recorded details for others to use. He may, however, develop powers of synthesis as he proceeds, and through successive steps of increasing constructive power attain some more responsible position. The risks of the naturally synthetic mind are different. If the young investigator is dexterous in presentment of his results, he may soon find himself advanced to a position of command. Then comes for him a testing time, when a decision must be taken whether administration or research shall dominate. The nature of his office will probably give

opportunity for both, and the precedence of one or other will be largely a matter of his own choice. At first the question rarely presents itself in an acute form. The cumulative effect of years often decides whether their victim shall quite unconsciously become part of an organising machine: or whether he shall continue to be a direct influence in creative science. Happy is the man who can do both.

It is not difficult to cite examples that illustrate these divergent results. In the lives of some of our greatest men the strangle-hold of administration has tended to choke the active spirit of personal observation. Among those who have passed away we may contrast the lives of Huxley and his friend Darwin. I well remember at South Kensington the glass jars holding material of the pearly nautilus which awaited the dissection that never found its place among Huxley's crowded hours of departmental committees and meetings of the Royal Society Council. On the other hand, Darwin, cloistered at Down, was free at a like age to continue his work on orchids and earthworms. Michael Foster and Thiselton-Dyer, who shared with Huxley the burden of the reorganisation of practical biology in the 'seventies, left little behind them as their published record beyond textbooks and official documents. Administration atrophied personal research in both of them. Even Bayley Balfour, who had shown his mettle as an investigator before he was thirty years old, spent his best period in ministering to the scientific wants of others: and only returned in his last years to the detailed systematic work in which he was a master. It is not for us to judge in such instances whether or not the results of administration have justified the sacrifice of personal opportunity for creative work. We are all debtors to these great men. But they are here cited as examples of a prevalent danger that grows more insistent as years advance. Administrative activity and continued personal research are conflicting factors in the individual life. The former has often become dominant even where the instinct of inquiry is strong.

Returning, in conclusion, to the intra-departmental aspect of this question, the most vital relation is between the professor and his students. How will his decision as to the balance between administration and research affect them? It may be urged, in support of giving priority to the former, that the smooth working of a well-organised department amply justifies the time and thought that it demands. The larger the department, the more pressing the demand will be: the students feel the result of good organisation, though few of them would analyse it back to the source. On the other hand, the effect of a prevailing atmosphere of research in a department is tonic and stimulating. It was the very essence of the Huxleyan revival that it converted every student into a potential investigator. The stimulus should emanate from the head of the department, passing either direct from him, or through lecturers and demonstrators to the individual student. But the method loses its point if the professor himself is in practice a mere administrator. Such chains of influence are felt rather than visualised; often the stimulus is almost unconsciously conveyed. An allusion in a lecture to experiences in the field, or an observation on material collected abroad, gathers up the attention of a class and makes it think more effectively than floods of fact at second hand.

A still more direct influence follows if a student penetrates with a question to the private room, and the professor rises from his microscope to reply; perhaps he may even allude to some observation that is interesting him at the moment. The student at once feels that he is in touch with the margins of knowledge. The opportunity for such touches is lost if the private room is a mere 'office'. I have found it sometimes known by that paralysing name. The undifferentiated private room, part laboratory part administrative centre, has qualities worth retaining not only for economy of space and time, but also in affording occasional completion of contact between the potential researcher and the professor actually at work.

Thus dangers lurk within the growing elaboration of a scientific department. Not the least of these will be to secure a due balance between administration and research in the person of its official head. Again I say, happy is the man who can hold the balance until strength itself fails. Among the distinguished graduates of Glasgow we possess two notable examples. Sir Joseph Hooker's youth was spent in acquiring experience and material; his middle age in working it up, in the intervals of administration as director of the Royal Gardens at Kew; in his old age he brought to completion systematic works of the greatest magnitude and value; but in the very last years of his long life we saw him still engaged in describing species new to science. On the other hand, Lord Kelvin continued the administration of his Department of Natural Philosophy for more than half a century; concurrently he carried on his own researches, and applied their results practically to the requirements of modern life. Until the day of his death he remained Chancellor of the University of Glasgow, and held the honourable title of a Research Student under Ordinance. Neither of these great men ever relaxed his hold upon personal observation. There is no stronger link than this between a professor and the real student.

Obituary

Prof. J. D. Cormack, C.B.E., C.M.G.

JOHN DEWAR CORMACK was born in 1870, a son of Alexander Cormack, rector of Dumbarton Academy. His career as an undergraduate at the University of Glasgow was a distinguished one, and those of his fellow students who are left still remember the successes and the prizes he gained at his class examinations.

In 1892, Cormack proceeded to Yorkshire College, Leeds, where he was appointed as lecturer in engineering subjects, specialising chiefly in electrical work. In 1896 he returned to Glasgow as assistant to the late Prof. Barr, and for some years acted as lecturer in electrical engineering. In 1901 he was appointed to the chair of mechanical engineering at University College, London, where he remained for twelve years. He took a prominent part in the affairs of the University of London and did conspicuous service on the engineering examining boards for both internal and external students.

In 1903, Cormack succeeded the late Prof. Barr as regius professor of civil engineering and mechanics at the University of Glasgow. He was welcomed back to his old college with enthusiasm, for his reputation as an exceptionally fine lecturer and teacher, as well as his prowess as a Rugby player and a golfer were well remembered. His appointment coincided with the affiliation to the University of the Royal Technical College, when much anxiety was felt over the possible troubles that might arise in the changes that would inevitably take place in the teaching and examination systems of both institutions. That the affiliation has been a great success was in a great measure due to the enthusiasm with which Prof. Cormack entered into the closer association of the two great engineering schools.

With the outbreak of war in 1914, Prof. Cormack gave up for the time his university work and placed his engineering knowledge at the disposal of the nation. His labours were largely in the aeronautical branch of war service. He occupied in succession the positions of chief contracts officer of military aeronautics, director of aircraft supply and equipment, and assistant controller of the aeronautical departments. From 1917 until 1919, he was in the United States as a member of the British Mission. In addition to the honours indicated by C.B.E., and C.M.G., he had the decoration of Chevalier of the Legion of Honour conferred upon him by the French Government; he was also an honorary brigadier general and honorary group captain R.A.F.

In 1932, Prof. Cormack was elected as president of the Institution of Engineers and Shipbuilders in Scotland, thus following in the footsteps of his famous predecessors in the engineering chair—Rankine, James Thomson, and Barr. His election indicated the esteem in which he was held by the Clydeside engineers and shipbuilders, and his term of office, which had only expired a few months before his death, will be long remembered for the quiet and efficient manner in which the business of both council and general meetings was conducted.

Prof. Cormack's death was sudden and unexpected. During the summer months he had been receiving medical attention, but he had taken up his university duties at the beginning of the session and was lecturing until a day or two before his death. A chill rapidly developed into pneumonia, and he died on Saturday, November 30.

As a professor of engineering Prof. Cormack was more attracted by teaching and administrative work than by experimental research. His students will long remember him for his lucid, well-delivered lectures as well as for the kindly interest he took in both their studies and college activities, and the efforts he made to start them in their engineering careers.

Dr. William MacDonald

THE death of Dr. W. MacDonald at the age of sixty years removes an enthusiast for South Africa and a firm believer in her future as the seat of a white civilisation. A Scotsman by birth and education, he spent some time studying in the United States and in France before settling in South Africa. There he realised that the prosperity produced by the recently discovered gold mines could only be stabilised by a concomitant development of agriculture, and he became the leading protagonist of his time for the dry-farming system. His two books—"Dry Farming" and "The Conquest of the Desert"—focused attention on what was, and probably always will be, one of the greatest obstacles to intensive agriculture in South Africa, and although modern policy is directed, perhaps wisely, towards encouraging extensive animal husbandry rather than the more intensive dry farming advocated by Dr. MacDonald, the influence of his work can be traced in the way that policy has developed. The growth of the citrus industry owes not a little to his encouragement in its early days. He had some of the enthusiasm of Cecil Rhodes for colonisation, and became director of the South African Land Settlement Bureau which did much to promote immigration before the Great War. He was proprietor, editor and a frequent contributor to the *Agricultural Journal of South Africa*, and was the prime mover in the institution of a faculty of agriculture at the University of Pretoria.

While MacDonald's life's work was in agriculture, he also took a deep interest in the mining industry, realising that this must be the real foundation on which a South African civilisation would be built. He is best known in England for his book "The Romance of the Rand" (1933), in which he gives a vivid account of the discovery of gold by his friend, Mr. F. Struben, and the early struggles of the pioneers.

News and Views

President Masaryk

IT was announced in Prague on December 14 that Prof. T. G. Masaryk, who has been president of the Czechoslovakian Republic since its foundation in 1918, has tendered his resignation. Prof. Masaryk was sixty-eight years of age when he returned to Prague at the end of the Great War and now, at the advanced age of eighty-five years, after guiding the destinies of the nation for seventeen years, he has expressed a wish to retire. Some time back he was taken ill with eye trouble and rheumatism, but he made a remarkable recovery and resumed duties and especially his reading of current scientific literature. During the Great War, Masaryk held a professorship at King's College, London, but his educational work receded as his powers as a statesman came to be recognised and utilised. His own efforts to secure the independence of Czechoslovakia were realised on October 28, 1918. Masaryk's long career has been a continual series of struggles in the interest of truth, both in science and in affairs. He began life as an apprentice to a locksmith but, through the efforts of his schoolmaster, continued his education at Brno Grammar School and the University of Vienna where, in 1878, he was awarded the Ph.D. degree.

MASARYK'S first philosophical work was "Suicide as a Social Phenomenon of the Present Day" (1881) and it secured for him a Vienna lectureship. In the following year he obtained a professorship at Prague, where at first the 'lonely Slovak' did not make many friends, and his scepticism (justified as investigation proved) of the genuineness of some old Czech manuscripts brought him much abuse. From his philosophical studies he was led to the formation of a 'Realist' movement. "Realism," he declared, "is an attempt to popularise the whole realm of science and philosophy. Without distorting scientific exactitude, realism strives to render science accessible to every class of the people. It is a protest against the monopoly of learning, its endeavour is to socialise scientific and philosophical culture." He married a distinguished American, Miss Charlotte Garrigue, in 1878, incorporating her name with his own. She entered ardently into all Masaryk's work until her death in 1923. They paid several visits together to England, America and Russia, and his wife undoubtedly helped him in the compilation of his philosophical works, especially when he was editor of the scientific section of the Prague daily, *Národní Listy*. Just before the Great War he wrote "Russia and Europe", one of the most important books on the subject, showing as it did the true state of the great Slav country and the directions in which affairs were drifting. His post-War books include "The Making of a State" (1927) and "Les Problèmes de la Democratie" (1924). He was also instrumental in the establishment of the Masaryk Academy of Work, which is concerned with the fostering of research, especially in such branches of applied science as chemical technology. Many valuable original memoirs have been published through the help of this Academy.

Tercentenary of Champlain

ON December 25 the tercentenary occurs of the death of Samuel de Champlain, the French explorer who founded Quebec, and was the first governor of Canada. Born in 1567 at the village of Brouage in the ancient province of Saintonge, now the Department of Charente-Inférieure, he served in the wars of the League under Henry IV, but after a voyage to the West Indies, he was placed in charge of an expedition to continue the work of Jacques Cartier, the discoverer of the St. Lawrence. On May 24, 1603, Champlain anchored in that river, and for the next four years was engaged on exploring the Bay of Fundy and other parts. A visit to France was followed by another expedition, and in July 1608 he founded the settlement which he named Quebec. Thence he made a journey up the Richelieu, and discovered and explored the lake which bears his name. Other explorations took him to the western shores of Lake Huron and to Ottawa. Again in France in 1620, he returned with his family and with a commission as governor of the new settlement. About seven years later, owing to the outbreak of war between France and England, his supplies were cut off, and Quebec had to be surrendered. After the declaration of peace, however, in 1633, he was again able to return, and it was in Quebec that he died. He wrote accounts of his voyages, and these were republished in Quebec in 1870.

British Association: Officers for 1936

THE annual meeting of the British Association will be held next year in Blackpool on September 9–16 under the presidency of Sir Josiah Stamp. The following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Prof. A. Ferguson; B (Chemistry), Prof. J. C. Philip; C (Geology), Prof. H. L. Hawkins; D (Zoology), Dr. Julian Huxley; E (Geography), Brig. H. S. L. Winterbotham; F (Economic Science and Statistics), Dr. C. R. Fay; G (Engineering), Prof. W. Cramp; H (Anthropology), Miss D. A. E. Garrod; I (Physiology), Prof. R. J. S. McDowall; J (Psychology), Mr. A. W. Wolters; K (Botany), Mr. J. Ramsbottom; L (Educational Science), Sir Richard Livingstone; M (Agriculture), Prof. J. Hendrick. The president of the Conference of Delegates of Corresponding Societies will be Dr. A. B. Rendle.

Prehistoric Research in South Africa

IN another column of this issue of NATURE (see p. 998) we publish an announcement of action taken by the Government of the Union of South Africa which will play a part of great importance not only in the advancement of the study of the prehistory of the sub-continent, but also ultimately, it may be asserted with confidence, in the elucidation of the whole problem of the distribution and development in culture of early man. The joint geological and archæological survey of certain sections of the Vaal and Riet River valleys, for which arrangements are being made by the Directors of the Geological Survey and the Bureau of Archæology of the Union, will cover an area which in the view of local archæologists, and indeed, as has been shown notably and convincingly by the exploratory work of Prof. C. van Riet Lowe, is of cardinal importance in the correlation of geological and archæological data in South Africa and the determination of their relation to evidence of climatic variation. As the survey will occupy fully the services of two geologists and an archæologist for at least eight months, the undertaking will be costly; but the expenditure is justified, even in present financial conditions, by the fact that this key area will be inundated when the dams now in course of erection across these rivers have been completed.

THE study of the prehistory of South Africa has made great strides in an incredibly short time, thanks to the enthusiasm of local archæologists and the insight with which they have applied and adapted to local conditions the lessons of European archæology. When, however, the survey now initiated has been completed and its results, whatever they may be, have been made available for correlation with those of analogous studies in other parts of the world, where the records of pluviation and glaciation are being interpreted and brought into relation, the study of prehistory at large will be deeply indebted to the Government of the Union of South Africa for its public-spirited promotion of this investigation while opportunity still served, and to the South African Association for the Advancement of Science for its services to research in urging upon the Government the desirability of an undertaking which not only will promote understanding of the conditions of a problem of the first importance in human history, but also holds out every promise of being of crucial influence in the future of prehistoric studies.

Sign Language as a Form of Speech

IN his Friday evening discourse at the Royal Institution on December 13, Sir Richard Paget discussed "Sign Language as a Form of Speech". The clue to the relationship between bodily gestures and the gestures of the mouth which produce speech was given by Darwin in 1872—namely, in the sympathy of movement between man's hands and his mouth. Charles Dickens, thirty years earlier, in "Pickwick Papers", had noticed the same effect. The deaf mute sign language is natural and universal among deaf mutes of all countries. The Red Indians of North America had a similar language of signs by which they could all communicate. In 1929, William Tomkins published his "Universal Indian Sign Language", which described 700–800 signs. The sign language of the aborigines of North-West-Central Queensland was described by Walter E. Roth in 1897. Garrick Mallery, writing in 1881 on the Indian sign language, described also the sign language of the Neapolitans. He concludes that all these languages are only dialects of a single language—the gesture speech of mankind. Recently, the Russian Academy of Sciences has discovered a sign language, used by women only, in Russian Armenia—also a pictographic script, twelfth to seventeenth centuries, which in many instances illustrates the sign language. Mr. Ivan Sanderson has recently discovered a sign language in the Cameroons; but hitherto gesture languages have been largely ignored. Many people think any alteration of spoken language is sacrilege; actually, all spoken languages are still primitive and unsystematic. Sign language is capable of great development as a universal language. Abstract ideas can be expressed in signs exactly as in spoken language—namely, by metaphorical reference to concrete ideas. Signs—unlike words—can be quantitative as well as qualitative, and shapes can be signed by direct imitation. In experimenting with the development of a new sign language, the vocabulary has been based on C. K. Ogden's 'Basic English' (850 words), but a much shorter sign vocabulary will suffice.

Archæological Museums

THE problem of the preservation and proper display of archæological collections and the associated 'finds' from the excavation of archæological sites is discussed by the Editor of *Antiquity* in the December issue of that journal. Briefly stated, the points to which he directs attention are two: the restrictions of space which preclude display according to modern methods, and differentiation to meet the respective needs of the 'ordinary' man and the student; and secondly, the necessity of a better organisation and distribution of the archæological material available for exhibition. In connexion with the second point, he is clearly preoccupied with the position of the British Museum (Bloomsbury), and here, as he points out, the question of reorganisation and distribution involves legislation. Further comment on the allocation of space to archæological exhibits may perhaps be postponed, pending the publication of a promised article in *Antiquity* which will deal with museum buildings.

THESE questions, however, serve to remind us that there are other aspects of the museum problem, which inevitably must be discussed, if, and when, the organisation of collections and their exhibition come under consideration. How far will it be advantageous, for example, to attempt to define the function of the local (that is, locally owned or municipally owned) museums, or to draft some scheme of co-operation between them and the

national collections, which would serve as the basis for a national system, in which museums of general cultural and archæological interest dovetailed with a grouping of auxiliary museums of localised or specialised function. That there is already a certain amount of co-operation, localisation and specialisation in action is, of course, well known. The university museums, having special functions, would have a special place in such a scheme. There is at present, in fact, a certain amount of specialisation as between the museums of the various universities, the Pitt-Rivers at Oxford being the most conspicuous example. In one direction the way has been pointed out by Dr. R. E. Mortimer Wheeler, in his address when declaring open the Bishop Hooper's Lodging as a folk museum at Gloucester on October 10 last. A report of his address and of the opening ceremony will be found in the *Museums Journal* of December. Dr. Wheeler's most suggestive remark was that pending, or the pessimist might say failing, the institution of a national folk museum, the local museum should set about the collection of the material of local folk culture before it is too late.

English Instrument Making

AT a meeting of the Newcomen Society held at the Science Museum on December 11, a paper by Dr. R. S. Clay and Mr. T. H. Court on "English Instrument Making in the 18th Century" was read. As is well known, Mr. Court has contributed largely to the collection of scientific instruments in the Museum. Some of these had been arranged on the lecture table, and during the reading of the paper Dr. Clay used them to illustrate his remarks. In the eighteenth century, he said, England was fortunate in having a number of men who were not merely instrument makers but also men of scientific knowledge. Moxon, Senex, Short, Dollond and Nairne were all fellows of the Royal Society, and they and others such as Benjamin Martin, George Adams and James Ferguson made advances in the construction of scientific instruments which placed English microscopes, telescopes, etc., in the forefront and caused them to be copied abroad. One important invention was that of Marshall, who introduced the method of grinding a large number of lenses together on a block with a spherical tool, another that of the method of drawing brass tubes on a steel mandrel by which tubes capable of sliding smoothly in one another for telescopes could be made. Cuff, it appears, first introduced an all-brass telescope as a commercial instrument. The invention of the achromatic lens by Dollond, the invention of the quadrant by Hadley, the improvement in dividing scales by Bird and Ramsden and the construction of reflecting telescopes by Short all contributed to the supremacy of the English instruments. The biographies of a few of the most famous instrument makers only are known. Short was one of the few who made money by his business ; a good many others were at various times made bankrupt. The outstanding men at the end of the century were Jesse Ramsden (1735–1800) and Edward Nairne (1726–1806).

Dr. R. A. Millikan and the Earth's Magnetic Field

EVER since the time of Gauss, it has been assumed that the intensity of the earth's magnetic field is practically symmetrical. When attempting to find out the nature and distribution of the cosmic rays, Dr. Millikan has discovered that we must seriously modify our ideas about the earth's field. According to a report by Science Service, Washington, D.C., Dr. Millikan in a paper read at a meeting of the National Academy of Sciences at Charlottesville, Va., stated that the magnetic field extends into space for at least 10,000 miles and that the magnetic intensity is stronger on the side of the earth opposite to America. There is a greater effect on the cosmic ray intensity from the north magnetic pole to the equator in the region of India than there is in comparable latitudes in America. The Department of Terrestrial Magnetism of the Carnegie Institution of Washington has compared the magnetic variations on the surface of the earth with Millikan's results determined by cosmic ray intensities. It concludes that the variations of magnetism extend many thousands of miles into space. The earth's field appears to be lopsided.

A Standardisation of Inefficiency

IN the *World Economic Survey* just issued by the League of Nations instructive statistics are given of the world production of electrical energy. Taking the average annual issue from 1925 until 1929 as 100, the issue in 1932 was 119, in 1933 it was 125 and in 1934 it was 138. Perusal of the *Survey* shows that in no other branch of industrial activity has such rapid progress been made during this period of great depression. *World Power* of October, in commenting on this, points out that the manufacture of plant does not increase *pari passu* with the demand for electrical energy. Part of the lag may be due to the great advances made in generating efficiency as a result of industrial research. This may have inspired a policy of caution among buyers of plant, and so they may be chary of placing new orders. It may be advisable to correlate technical research and new orders for electrical development, if overseas countries continue to protect inefficient installations by obsolete standardisation regulations. *World Power* states that scientific investigation is likely to receive a severe setback because research work will lack a world market for the products it improves. A secondary boom tends to develop in the sheltered manufacturing industries abroad, which receive added protection from the depreciation of the exchange. A number of foreign countries with depreciated exchanges are adopting plant and equipment regulations which give results much inferior to those obtained by research and the best technical practice. There is in fact a tendency towards standardising inefficiency, and this discourages scientific research.

Modern Physics

OF the series of pamphlets recently issued in Paris by Messrs. Hermann et Cie under the title "Actualités

Scientifiques et Industrielles", six deal with physical questions. M. Jean Perrin, under whose direction the pamphlets dealing with atomistics are issued, is himself responsible for four entitled "Grains de Matière et de Lumière". The first is on the existence of the 'grains', that is, of atoms, electrons and photons, the second on the structure of the atoms, the third on the complexity of their nuclei and on their radio-activity, and the fourth on the changes which can be produced in them by bombardment. Prof. Joffé of Leningrad, who is dealing with the physics of solids, contributes a somewhat longer pamphlet, on semi-conductors, the conductivity of which is due to a small fraction only of the valence electrons attached to their atoms. M. Y. Rocard presents the first pamphlet of the series on hydrodynamics and acoustics, on the statistical theory of fluids and the equation of state, by M. J. Yvon. Each pamphlet gives a concise and readable account of the present state of the subject with which it deals, and is written by one who has himself made distinct and valuable contributions to our knowledge of it.

Radio Data

A SECOND edition of "Radio Data Charts" by Dr. R. T. Beatty (Iliffe and Sons, Ltd. 4*s*. 6*d*. net) is to be welcomed, since the opportunity has been taken to extend its scope to cover the most recent advances in radio technique. The various abacs provided now cover wave-lengths down to five metres, while provision is made for audio-frequencies over the range 20–10,000 cycles a second. This publication contains a series of thirty abacs with explanatory notes and examples, by means of which many of the quantities required in radio-frequency work can be obtained directly without the necessity for laborious calculation. In addition to the means for obtaining the inductance, capacitance and reactance of coils and condensers at both audio- and radio-frequencies, charts are given for obtaining the efficiency and time constant of a grid leak and condenser combination, for designing coils to have a minimum radio-frequency resistance and for the design of attenuation circuits, to select only a few typical examples. The whole series of charts is printed in a clear and easily accessible form and will be found to be most valuable to engineers, experimenters and students dealing with radio-frequency work.

Clough Memorial Research Fund for Geology

THROUGH the generosity of Mrs. Clough, a fund was established in 1935 in memory of her late husband Dr. C. T. Clough, for the purpose of encouraging geological research in Scotland and the north of England. The north of England is defined as comprising the counties of Northumberland, Cumberland, Westmorland, Durham and Yorkshire. Under the terms of administration of the fund a sum of approximately £30 will be available annually. Applications for grants for the period April 1, 1936–March 31, 1937 should state the nature of research to be undertaken, amount of grant desired, specific purpose for which the grant will be used and whether any other grant-in-aid has been obtained or applied for; they should be in the hands of the Secretary, Clough Memorial Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh, not later than February 1, 1936.

Statistics of the British Cinema Industry

AT the meeting of the Royal Statistical Society on December 17, Mr. S. Rowson read a paper entitled "A Statistical Survey of the Cinema Industry". When the figures disclose that in 1934 there were 957 million admission tickets sold for the sum of £40,950,000 (the average price of a ticket thus being 10·3*d*.), and when one further considers the character and splendour of the modern cinema together with the fact that four out of every five people visiting the cinema pay not more than one shilling for a ticket, the cinema is shown to be as one of the sociological wonders of the century, meriting attention and investigation. Of the year's revenue from admissions, the Government claimed £6,800,000 in entertainment duty. The average weekly cinema attendance throughout the year is about 18½ millions. At the end of 1934 there were 4,305 cinemas in Great Britain, with an average of 900 seats in each. In the London postal area alone, there were 401 cinemas. Of the various districts Lancashire had the greatest number with 699, Midlands next with 585, and Yorkshire and district next with 534. North Wales had the smallest number with 62—as opposed to 259 in South Wales. In the London area there was one seat for every 14 of the total population; in the Lancashire area one to nine; in the eastern counties one to nineteen; in South Wales one to ten. Eliminating the population under 15 as infrequent cinema-goers—the number of persons per seat were: in London, 10·9; in the Eastern Counties, 14; in the Midlands, 9·6; in Yorkshire, 8·0; in Lancashire, 7·0; and in South Wales, 7·6. It will be seen from the foregoing that the problem of redundancy or overbuilding is now becoming serious.

Food of the Bullfrog

MR. S. W. FROST had a bullfrog of 200 gm. under observation in a cage provided with a small pond ("The Food of *Rana catesbeiana*, Shaw", *Copeia*, No. 1; 1935). Its feeding capacity is amazing. During the summer it ate more than four hundred and twenty-seven grams of food—more than twice its own weight—in less than five months. The artificial conditions may, however, have caused it to eat more than it would have done in natural surroundings. The food eaten included 56 amphibians (frogs, toads and salamanders), 63 insects (beetles, moths, caterpillars, grasshoppers and cicadas), slugs (*Limax maximus*) and birds. As an example, on June 23 it ate 2 Promethia moths and 8 other insects; June 24, 1 Promethia moth, 3 other insects and 1 nestling sparrow (18 gm.); June 25, 1 frog (6 gm.); June 16, 2 frogs (13·5 gm.). It has a curious method of accepting its food, preferring to take it under water; "sometimes it snatches a morsel of food on the bank of a stream or pond, but invariably jumps into the water and submerges it to swallow".

Swimming Baths and Pools

THE Minister of Health has directed the attention of local authorities for the necessity of cleanliness in swimming pools (Circular 1503. London: H.M. Stationery Office, price 1*d*.). The circular emphasises the opportunity which the winter months offer for ensuring a proper standard in swimming baths and pools. The requisite degree of purity can best be maintained by efficient continuous filtration and continuous controlled chlorination. The recommendations apply to all baths and pools open to the public, whether publicly or privately owned, for local authorities, under the Public Health Act, 1875, have power of control over privately owned pools used by the public.

Pathology and Bacteriology at Leeds

THE annual report for 1934 of the Department of Pathology and Bacteriology in the University of Leeds has been issued, and gives a brief account of the routine and research work prosecuted under the direction of Profs. Stewart and McLeod. The research work includes studies on industrial pulmonary diseases, diphtheria, immunity, and catarrhs of the respiratory tract. Prof. Passey contributes an abstract of work done in cancer research.

Harrison Memorial Prize, 1935: Dr. L. E. Sutton

AT the meeting of the Harrison Memorial Prize Selection Committee, consisting of the presidents of the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry, and the Pharmaceutical Society, held on December 12, it was unanimously decided that the Harrison Memorial Prize for 1935 should be awarded to Dr. Leslie Ernest Sutton. The presentation of the Prize will be made at the annual general meeting of the Chemical Society to be held at the University of Bristol on Thursday, April 16, 1936. Dr. Leslie E. Sutton was educated at Watford Grammar School, and proceeded to Lincoln College, Oxford, in 1925, obtaining his B.A. and B.Sc. with first-class honours in 1929. He was elected senior research scholar of the Department of Scientific and Industrial Research in 1929, and obtained his D.Phil. and fellowship of Magdalen College in 1932. He worked with Prof. P. Debye at Leipzig and with Prof. L. Pauling at the California Institute of Technology, Pasadena, and during the past five years he has been carrying out research at Oxford. His original investigations on dipole moments, including the relation between moments and orientation in benzene substitution, on valency angles, and on electron diffraction are of outstanding merit, and form a notable contribution to our knowledge of physical chemistry.

"Everyday Science" and the Civil Service Commissioners

OUR leading article this week deplores the removal from examinations for higher administrative posts of the Civil Service of the compulsory subject "Everyday Science". In this connexion, Sir Arnold Wilson put a question in the House of Commons asking the Secretary to the Treasury "whether he is aware that the Civil Service Commissioners have eliminated the subject of everyday science, which has been one of the obligatory subjects for competitive examinations for the administrative group of Government service, from next year's examinations; and whether, before taking this decision, the Civil Service Commissioners consulted any society or body representing educational and scientific interests". The reply given on December 16 by the Financial Secretary to the Treasury was as follows: "The answer to both parts of the question is in the negative." The curtness of the reply borders almost on discourtesy to the scientific and educational bodies concerned; and we trust that the matter will not be left in the present unsatisfactory position.

Scales of Ordnance Survey Maps

IN reply to a question by Colonel A. W. Goodman in the House of Commons on December 12, the Right Hon. Walter E. Elliot, Minister of Agriculture, stated that "no decision has been taken to introduce the metre as a unit of measurement in Ordnance Survey maps. The question is among those to be examined by the Departmental Committee, which is at present considering the future programme of the Ordnance Survey Department."

Committee against Malnutrition

IN the anniversary address to the Royal Society (NATURE, Dec. 7, p. 895), Sir F. Gowland Hopkins mentioned a "self-constituted committee" issuing "propaganda against malnutrition". This Committee —a body of research workers and members of the medical profession—is the Committee against Malnutrition, 19c Eagle Street, Holborn, W.C.1. The Committee issues a two-monthly bulletin dealing with all aspects of modern nutritional research and of malnutrition as a social question. The annual subscription is 3*s*., and in the case of associates 5*s*., a sum which entitles them to the full use of the files and library of the Committee.

Fifth Mount Everest Expedition

IT is announced that the party which will make the fifth attempt to climb Mount Everest in the 1935–36 expedition under the leadership of Mr. Hugh Ruttledge has been chosen by the Mount Everest Committee, of which Major-General Sir Percy Cox is chairman. The members of the party will be Mr. E. E. Shipton, leader of the Mount Everest reconnaissance party in Tibet; Mr. F. S. Smythe, who has taken part in three previous expeditions; Mr. P. Wyn Harris (Kenya Civil Service); Dr. C. B. Warren, formerly of St. Bartholomew's Hospital; Mr. E. G. H. Kempson, a master at Marlborough College; Major C. J. Morris, late 2nd/3rd Gurkha Rifles; Dr. Noel Humphreys, who led the Oxford University Expedition to Ellesmere Land last year; Lieut. W. R. Smijth-Windham, Royal Corps of Signals; Lieut. J. M. L. Gavin, Royal Engineers; Mr. F. H. L. Wigram, a medical student at St. Thomas's Hospital; and Lieut. P. R. Oliver, South Waziristan Scouts.

Physical Society's Exhibition

THE twenty-sixth annual exhibition of scientific instruments and apparatus, arranged by the Physical Society, will be held on January 7, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7. Manufacturers of scientific instruments will be exhibiting their products in the Trade Section. The Research and Experimental Section will contain contributions from research laboratories, and there will be a special sub-section devoted to experiments of educational interest. In addition, the work submitted for the Craftsmanship and Draughtsmanship Competition by apprentices and learners will be on view. Discourses will be delivered on two days at 7.45 p.m. as follows: January 7, R. A. Bull, "Some Instruments used in recording Sound on Film"; January 8, R. W. Paul, "Electrical Measurements before 1886". Admission to the exhibition is by ticket only. Members of institutions and scientific societies may obtain tickets from their secretaries; tickets may also be obtained direct from the Exhibition Secretary, 1, Lowther Gardens, Exhibition Road, S.W.7.

American Association for the Advancement of Science

THE American Association for the Advancement of Science will hold its ninety-seventh meeting at St. Louis, commencing on December 30. On the first evening, the retiring president, Dr. Edward L. Thorndike, will deliver an address entitled: "Science and Values". Among the special lectures are J. B. Taylor, "The Electric Eye and the Human Eye" (Sigma xi Address); Prof. J. E. Woodridge, "The Claims of Science" (first of series of annual lectures to be arranged by the United Chapters of Phi Beta Kappa); Dr. H. G. Moulton, "The Scientific Method in the Investigation of Economic Problems"; Dr. B. A. Houssay, "Hypophysis and Metabolism"; Dr. Karl F. Meyer, "Plague, Past and Present"; Dr. E. H. Barbour, "The Proboscidea of the Plains"; Prof. F. Slocum, "The Changing Picture of the Universe"; Dr. V. O. Knudsen, "The Absorption of Sound in Gases"; Dr. V. Bush, "Mechanical Analysis" (Josiah Willard Gibbs Lecture). A meeting will also be arranged between the secretaries of sections and affiliated societies and representatives of the Press to discuss the broader principles or the technique of the popular presentation of science. Further information can be obtained from the Permanent Secretary, Dr. Henry B. Ward, Smithsonian Institution Building, Washington, D.C.

Announcements

WE much regret to announce the death, which occurred on December 16 at the age of eighty-one years, of Sir Richard Glazebrook, K.C.B., K.C.V.O., F.R.S., from 1889 until 1919 director of the National Physical Laboratory, and from 1908 until 1933 chairman of the Aeronautical Research Committee; also of Mr. P. C. Gilchrist, F.R.S., who was associated with the late Mr. S. G. Thomas in the introduction of the basic Bessemer process for the production of iron, on December 15, aged eighty-three years.

IT is announced that the King has been pleased to appoint Mr. Edgar John Forsdyke, keeper of the Department of Greek and Roman Antiquities at the British Museum, to be director and principal librarian of the Museum, in succession to Sir George Hill, who will retire in Midsummer, 1936.

DR. G. A. YOUNG, chief geologist of the Canadian Geological Survey, has been elected president of the Royal Society of Canada in succession to the late Dr. Reginald W. Brock.

PROF. OTTO LEHMANN, director of the Museum at Altona, has been awarded the Goethe Medal for Science and Art.

A MEDALLION has recently been affixed to the house at Confolens in the Department of Charente, in which the late Dr. Emile Roux, the director of the Pasteur Institute of Paris, was born.

IT has been arranged for a number of the official lectures which are being given in connexion with the Exhibition of Chinese Art at Burlington House, to be published in the *Journal of the Royal Society of Arts*. The first of these, "The Chinese Exhibition", by Sir Percival David, has already appeared, and Miss Helen Fernald's lecture on "The T'ang T'ai Tsung Horses" is being published on December 20. Copies may be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, W.C.2, price 1*s*. each.

A SPECIAL section of the Illuminating Engineering Society to be devoted to photometry and allied subjects is now being formed. The honorary secretary is Mr. K. F. Sawyer, of the Gas Light and Coke Company, Watson House, Nine Elms Lane, London, S.W.8. Arrangements have been made for the opening meeting to take place at the Westminster Technical Institute, Vincent Square, London, S.W.1, at 6.30 p.m. on January 28. An introductory address, dealing with certain outstanding problems in photometry, will be delivered by Dr. J. W. T. Walsh.

ERRATUM.—In the communications by G. Wald entitled "Pigments of the Bull Frog Retina" (NATURE, Nov. 23, p. 832) and "The Visual Purple System in Marine Fishes" (NATURE, Dec. 7, p. 913), the ordinates of the graphs should read "Extinction (log I_0/I)" instead of "Extinction (109 I_0/I)" as printed.

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

A John William Hughes professor of civil engineering in the University of Liverpool—The Registrar (Feb. 10).

A principal of the Leathersellers' Technical College—The Clerk to the Governors, Leathersellers' Hall, St. Helen's Place, London, E.C.3.

An engineer to the Government of Nigeria—The Crown Agents for the Colonies, 4, Millbank, London, S.W.1.

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 991.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Biometrical Studies on Herbarium Material

ONE type of information concerning species is almost universally lacking in herbarium material, even in that of the most copiously collected species and varieties of plants. Because the lack seems to be due to a general failure to appreciate the value of such information, it has seemed wise to direct attention to the problem, and to indicate methods of dealing with it.

For species which are well represented in herbaria, one can now obtain from the preserved specimens a substantially accurate record of the general range of variation. Seldom or never, however, is it possible to ascertain the comparative frequency of the different variants. In *Fraxinus Pallisae*[1], for example, it is difficult to decide whether one is dealing with various departures from a common morphological central type, or whether the bulk of the population is grouped around two or more extremes with occasional intermediates between them. If information as to frequencies were at hand, it would very probably be possible to diagnose one variable but still coherent species, or, alternatively, to explain the result as due to hybridisation.

In such variables as *Fraxinus Pallisae* and *F. oxycarpa*, it is possible to supplement the customary herbarium material with another kind of specimen which will supply exactly the information which is ordinarily lacking. These supplementary specimens need be little or no more laborious to collect than ordinary ones, nor, if the work be critically done, need they take up undue space in the herbarium. All that is needed, in addition to the kind of specimens usually collected, is a series giving a random sample of the population. This need not consist of complete specimens; any critical portion of the plant will probably suffice. In *Fraxinus*, for example, one leaf per tree, from every tree in a small copse, or from a random sample of the trees in a forest, can be mounted several to a sheet. While the specimens need not be bulky, they should be carefully chosen to be as comparable as possible; in *Fraxinus* they should all be leaves in the sun, or all in semi-shade; they should all be either from fruiting or non-fruiting branches, and if possible from trees of about the same age. Different genera will require other sorts of material. In *Iris* one seed from every one of the plants in a meadow, in *Prunus* one average 'stone' per tree from all the trees in a single mountain valley or along a certain length of beach, in *Centaurea* one head from every plant growing on an area of down, will produce collections which can be filed in packets on a single sheet. Such collections, however, if carefully gathered, will yield valuable and unique biological information.

It is important, of course, that, where great numbers of individuals make it necessary for the collector to choose relatively few, the choice be made as representative as possible. One of the simplest ways of accomplishing this result is to collect along a line (or if necessary along a series of parallel lines) until the necessary number of individuals has been sampled. With low-growing plants it is usually a simple matter to sight across such a community as a meadow or a bog where the plants are growing and to pick out a route which will be representative, and then to collect comparable fragments (leaves, flowers, seed-pods, etc.) of every plant along this line. Some modification of this method will ordinarily suffice for larger-growing species, though more mathematically refined methods for taking such samples might readily be devised[2]. The number of individuals collected will depend, of course, upon the ease of collection, and to a certain extent upon the needs of the particular problem under investigation. Generally speaking, at least twenty-five will be necessary before one can place much confidence in the result, while samples of more than fifty may not give such improved results as to justify the extra labour.

In our opinion, such collections, if once made, should be filed together, even though they may include two or more species. Once separated into their specific components, they are difficult and sometimes impossible to reunite. Cross-references can be made on the orthodox herbarium material, which, of course, should be collected at the same time. There does not seem to be any inherent difficulty either in assembling such material or in filing it in a regular herbarium. It is to be hoped that such collections may be made more frequently, especially from species or groups of species which are difficult or impossible to diagnose precisely by more orthodox taxonomic methods.

Washington University, St. Louis, Missouri. E. ANDERSON.

Royal Botanic Gardens, Kew, Surrey. W. B. TURRILL.

[1] Tedd and Turrill, "*Fraxinus Pallisae* and its Relationships", *Kew Bull.*, **132**; 1935.
[2] A. R. Clapham, "The Form of the Observational Unit in Quantitative Ecology", *J. Ecol.*, **20**, 192; 1932.

Meaning of Certain Constants in Use in Physics

RECENT discussions as to electrical units have led to a consideration of the meaning of the constants μ, K, A, employed in electrical theory. It appears that each of these is needed, as a link, to allow us to express in dynamical ('absolute') units the forces active between certain electrical and magnetic quantities. Thus we have

$$\text{Force} = mm'/\mu r^2$$

and two similar equations, where m, m' are quantities of magnetism.

It is of course the case that μ, or more accurately μ/A, measures the ratio of magnetic induction to magnetising force, the permeability of the medium, while K, or rather $K/4\pi$, is a measure of its permittivity, the ratio of electrical displacement to electric force, but these facts are consequences of theory rather than fundamental definitions of the coefficients μ and K. The object of this note is to direct attention to the fact that many other coefficients used in physics share this role with μ and K.

Hooke's law, "Ut tensio sic vis", might be made the basis of a definition of force; indeed, it is used in the spring balance as a measure of force. A coefficient, Young's modulus, gives us the link by means of which we can express the stretch (tensio, extension) of a spring or piece of elastic in dynamical measure. This is true of all coefficients of compressibility or rigidity. By means of them we are enabled to express dynamically the pressures or tractions required to change the volume or shape of a body by a given amount.

Nor is this use of a coefficient limited to cases in which force is one of the quantities measured. Heat is properly measured as energy; it can also be measured by the rise of temperature produced in a given mass of water. Joules' equivalent is a coefficient which enables us to express a rise of temperature as the ratio of energy to the mass of water; the result is not completely 'absolute', for it involves certain properties of water.

Or again, to take a case involving, no doubt, the properties of a quantity of electricity, the electron, Planck's constant gives us the ratio of a quantity of energy to the frequency of an electron and thus enables us to express the frequency of an electron in dynamical units.

R. T. GLAZEBROOK.

Ballards Oak,
Limpsfield,
Surrey.
Dec. 2.

Production of Neutrons by Annihilation of Protons and Electrons According to Fermi's Theory

IN the theory of β-decay as proposed by Fermi[1], one assumes the existence of elementary processes in which a neutron is transformed into a proton by simultaneous creation of an electron and a neutrino. For the inverse process, which is also naturally contained in Fermi's theory, one needs the previous existence of an electron and a neutrino. It might therefore be thought that a proton cannot be transformed into a neutron without the presence of a neutrino source. Such a source, however, is not necessary if it be admitted that in empty space all negative neutrino states are occupied in the same way as the negative energy states of the electron in Dirac's theory of the positron. In this case, for example, the presence of an electron alone is sufficient since the neutrino can be furnished from a negative state.

The transformation of protons into neutrons by positron emission has already been treated by Uhlenbeck and Wolfe[2]. Of course, it could only occur if for the masses M_P, M_N and m of proton, neutron and electron respectively, the relation

$$D = M_N c^2 - M_P c^2 < -mc^2 \qquad (1)$$

were valid. Recent data for the neutron mass seem to exclude such a relation.

By a process of the kind mentioned above, however, the proton in the hydrogen atom together with the electron can be transformed into a neutron, if

$$D < mc^2 - J, \qquad (2)$$

J being the ionisation energy.

Since, at present, relation (2) cannot be excluded with certainty, we have calculated the rate of transition of a hydrogen atom into a neutron. The result depends somewhat on the form of the interaction between the heavy particle and the electron-neutrino field. We have used two such forms, that proposed originally by Fermi (l.c.), the other by Konopinski and Uhlenbeck[3], and we find in the former case:

$$R' = \frac{\Delta^2}{T}; \qquad (3a)$$

and in the latter,

$$R'' = \frac{\Delta^4}{T}; \qquad (3b)$$

where

$$T = \frac{2\pi^2\hbar^4}{g^2\alpha^3 m^2 c} = 8{\cdot}8 \times 10^{10} \text{ sec.} \qquad (4)$$

and

$$\Delta = \frac{mc^2 - J - D}{mc^2} \qquad (5)$$

g is the universal constant as determined by the β-decay with the value $g = 4 \times 10^{-50}$ cm.^{3} erg; $2\pi\hbar$ is Planck's quantum of action; α is the reciprocal of the Bohr radius; c is the velocity of light; and J is the ionisation energy of the hydrogen atom.

If by a very cautious estimation we assume that the lifetime of hydrogen is certainly longer than 10^{13} sec., we find as a lower limit of D from (3a):

$$D > 0{\cdot}9\ mc^2 = 4{\cdot}5 \times 10^5 \text{ e.v.}; \qquad (5a)$$

from (3b):

$$D > 0{\cdot}6\ mc^2 = 3 \times 10^5 \text{ e.v.} \qquad (5b)$$

Since it is very likely that not only are the relations (5) satisfied but also that D is considerably larger than mc^2, a transformation of protons into neutrons could only occur by bombardment with electrons of high energy. We have also treated this case neglecting the Coulomb interaction between the proton and the electron. For the cross-section we obtain with

$$\Gamma = \frac{E - D}{mc^2},$$

in the Fermi case

$$\Phi' = A \frac{c}{v} \Gamma^2; \qquad (6a)$$

in the Uhlenbeck case

$$\Phi'' = A \frac{c}{v} \Gamma^4. \qquad (6b)$$

E and v are energy and velocity of the incident electron; A is the universal area

$$A = \frac{g^2 m^2}{2\pi\hbar^4} = 1{\cdot}7 \times 10^{-44} \text{ cm.}^2 \qquad (7)$$

The smallness of the value (7) will scarcely permit detection of our effect, although it increases rapidly with the electron energy. Our calculations have been carried out on the assumption that the mass of the neutrino is small compared with the mass of the electron. In addition, for simplicity, terms of the order m/M have been neglected.

Universitetets Institut for Teoretisk Fysik, København.
Oct. 26.

F. BLOCH.
C. MØLLER.

[1] E. Fermi, *Z. Phys.*, **88**, 161; 1934.
[2] *Phys. Rev.*, **46**, 237; 1934.
[3] *Phys. Rev.*, **48**, 7; 1935.

Conditions Determining the Intensity of X-Ray Reflections from Microcrystalline Layers

THE letter of Messrs. Stephen and Barnes on a "New Technique for Obtaining X-Ray Powder Patterns" in NATURE of November 16, p. 793, raises some points of interest with regard to the geometrical-optical conditions governing the device they describe.

As is done in the flat layer method we have developed[1], they observe X-ray reflections from a flat microcrystalline layer by making use of wide beams. The X-ray source is at some distance from the camera and the layer is set so as to make only small glancing angles with the reflected rays. Such conditions correspond to our focusing relation $\sin\alpha/\sin\beta = a/b$ for the case $a > b$. In Fig. 1, this relation is illustrated by reference to the 'toroidal' surface, discussed in previous papers[2], which determines the locus of the points so situated as to reflect from a source A to C through an angle $2\pi - (\alpha + \beta)$. Since the magnification between A and C depends on the zone of the toroid, by making $a > b$ a reduced image of the source with a corresponding increase of intensity can

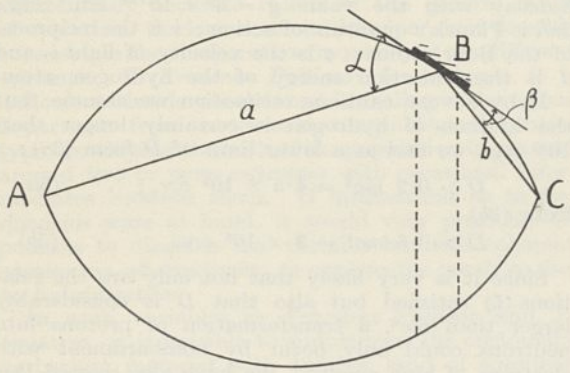


FIG. 1.

be obtained. Apart from this factor of magnification, the intensity is determined by the angular width of the incident beam. To obtain the maximum intensity we have met these combined requirements by placing the source A, which generally is a slit, back in the anticathode itself. The multiple diaphragm used by Messrs. Stephen and Barnes approximates to these conditions, as for a parallel beam $a = \infty$, when the focusing relations always requires the angle β to be small. It would thus appear that their method is in its principles the same as our method of the flat layer. Although they do not use the term focusing, the sharpening of lines and the increased intensity with shortening of exposure are two aspects of focusing and scarcely involve a new principle, claimed in the letter.

This view seems to be supported by Dr. W. H. George's elegant method[3] referred to in Messrs. Stephen and Barnes' letter, of obtaining a strong monochromatic reflection from a copper crystal cut so that its surface is oblique to the reflecting lattice planes. This corresponds to the reflection from an element of the toroid with $a \neq b$, and is entirely accounted for by the focusing relations; we described this in our earlier discussion by saying "that the lattice planes from which reflection takes place are inclined to the surface of the toroid like the tiles of a roof". They are indicated in Fig. 1 by the shaded lines at B.

We look forward to finding in the more extended publication foreshadowed by Messrs. Stephen and Barnes a fuller exposition of the distinctive features of their method and of the underlying principles. In some measurements with a source A at finite distance and a flat microcrystalline layer, we found that with decrease of β below the angle of focusing the intensities did not increase but decreased in accordance with an absorption effect[4] which could not be discussed within the limits of this letter.

J. BRENTANO.

Physical Laboratories,
University,
Manchester.

[1] J. Brentano, NATURE, **112**, 652; 1923. *Proc. Phys. Soc.*, **37**, 184; 1925.
[2] J. Brentano, *Arch. Sci. Phys. et Nat.*, (4), **44**, 66; 1917; (5), **1**, 550; 1919. Also loc. cit.
[3] W. H. George, NATURE, **136**, 180, Aug. 3, 1935.
[4] J. Brentano, *Z. Phys.*, **70**, 74; 1931. *Proc. Phys. Soc.*, **47**, 932; 1935.

Variation in the Lattice Constant of Zinc Oxide

IN the course of electron diffraction investigations, it is often necessary to have a more accurate method of measuring voltage than the spark gap affords. Reference films have been used by several workers, the electron voltage being calculated from the lattice constant as known from X-ray work. Gold films were originally used, but more recently metallic oxide films have been preferred, as they yield very good diffraction patterns. The use of such films obviously demands that the crystal structure shall be stable and the lattice dimensions constant.

During the past three years, I have been using both gold and zinc oxide films in this way. Whilst the former have behaved uniformly well, the latter have showed small but consistent variation in lattice constant, as tested against a high-resistance voltmeter. It is conceivable, but scarcely possible, that both the voltmeter and gold film varied, and that the zinc oxide films were actually stable.

The oxide films were prepared by withdrawing a brass washer of 5 mm. diameter from a skimmed melt of granulated zinc contained in a crucible. The lattice constants of such a newly prepared film were found to be: $a = 3{\cdot}234 \pm 0{\cdot}005$ A.; $c = 1{\cdot}615 \pm 0{\cdot}005$ A. After an interval of one year, during which the film was protected from dust but was exposed to the air, the constants were found to be: $a = 3{\cdot}262 \pm 0{\cdot}005$ A.; $c = 1{\cdot}628 \pm 0{\cdot}005$ A. Six months later the values were found to be slightly higher still: $a = 3{\cdot}279$ A. and $c = 1{\cdot}637$ A., with the same probable error as before. No changes in these latter values were observed after the lapse of a further two months. To check this drift in the lattice constants, a fresh zinc oxide film was then prepared. This gave values very near to those first obtained with the previous film: $a = 3{\cdot}242$ A., $c = 1{\cdot}620$ A. These values compare with those given by Bragg[1]: $a = 3{\cdot}220$ A., $c = 1{\cdot}608$ A.; the difference is not significant, as there is a constant error of $\pm 0{\cdot}5$ per cent in the present work, owing to uncertainty as to the camera length. This error will affect all the values equally, and therefore can have no part in causing the observed drift.

The fact that the lattice constants of zinc oxide films vary in this regular way with time, whilst those of gold films remain constant, must be the result of stresses set up in the films during the rapid cooling

which accompanies their formation, possibly aided by gas absorption. No work has been done on films obtained by collecting zinc oxide smoke[2]. The present results show, therefore, that it is inadvisable to use films of zinc oxide, prepared in the manner described, for high-voltage calibration or measurement.

V. E. COSSLETT.

H. H. Wills Physical Laboratory,
University, Bristol.
Oct. 31.

[1] Bragg, *Phil. Mag.*, **39**, 647; 1920.
[2] Finch and Quarrell, *Proc. Phys. Soc.*, **46**, 148; 1934.

Ascorbic Acid (Vitamin C) and Phytocarcinomata

IN a previous communication[1], I have given an account of a phytocarcinogenic effect of œstrus hormone on tomato plants. In a similar preliminary experiment using the same technique[2] with tomato plants, about 55 cm. high, the effect of ascorbic acid upon plant-tumour production has been investigated.

Immediately after the inoculation of fifteen plants with *B. tumefaciens*, a 1/10,000 aqueous solution of ascorbic acid (kindly supplied by Prof. A. Szent-Györgyi) was introduced through a petiolar stump. The average total dose thus absorbed was about 27 ml. per plant during the period June 8–22, 1935. Five of the fifteen were tentatively given, on the first day of the experiment, 5 ml. of a concentrated (5/1,000) solution of ascorbic acid. Although the petiolar stump, through which this dose was absorbed, plasmolysed and completely collapsed within 38 hours, no other toxic effects were observed. Afterwards, the dilute solution was given to these plants through another petiolar stump. Twenty-one plants were set up as controls, and treated with an equal amount of water.

At the first signs of necrosis of the experimental tumours, they were cut off and weighed. The average weight of the tumours per plant was: with ascorbic acid, 1·116 gm.; with water only, 0·857 gm. The mean weight of the tumours of the plants treated with ascorbic acid was about 27 per cent greater than that of the control plants, although the total amount of crystalline ascorbic acid administered throughout the treatment amounted only to about 2·7 mgm. per plant; owing to its rapid oxidation in solution, the amount actually absorbed is estimated to have been 40–50 per cent less.

The hydrogen ion concentration of the sap of the treated plants and controls, and of the tumours severed from these plants, was as follows (mean values):

	Concentration of solution	*p*H 24 hours after absorption of first solution	*p*H at end of experiment
Leaves	1/10,000	5·6	5·6
	5/1,000	5·4	5·6
Leaves and stem	1/10,000	—	5·5
	5/1,000	—	5·5
Tumours	1/10,000	—	5·8
Leaves	0 (controls)	5·6	5·6
Leaves and stem	0 „	—	5·5
Tumours	0 „	—	5·8

With the exception of the slight lowering of the *p*H of leaf-sap extracted twenty-four hours after the administration of the stronger solution of ascorbic acid, the acid does not appear to have affected the hydrogen ion concentration of the sap extracted from the treated plants. The greater alkalinity of tumour sap is a characteristic of most tumour tissues.

Histo-cytological examination of tumours from the treated and control plants gave no indication that the increased size of the tumours severed from treated plants was simply due to the stretching of the cells caused by a general stimulation of somatic growth under the influence of ascorbic acid[3]. As the size and arrangement of the cells and that of the phloem-xylem elements were identical in the two, it is deduced that the treatment led to an increase of cell proliferation of the pathological tissues.

It is hoped to extend the range of the experiment outlined above, in order to test whether a parallelism exists, for plants, with the findings of Fodor and Kunos[4], Schroeder[5], and Frisch and Willheim[6], concerning the carcinogenic influence of ascorbic acid on animals.

LÁSZLÓ HAVAS.

Hungarian Biological Research Institute,
Tihany, Hungary.
Nov. 14.

[1] Havas, L., NATURE, **136**, 516, Sept. 28, 1935.
[2] Havas, L., and Caldwell, J., *Ann. Bot.*, **49**, 731; 1935.
[3] Havas, L., NATURE, **136**, 435, Sept. 14, 1935.
[4] Fodor, E., and Kunos, St., *Z. Krebsforsch.*, **40**, 484; 1935.
[5] Schroeder, H., *Klin. Wochenschr.*, **14**, 484; 1935.
[6] Frisch, C., and Willheim, R., *Biochem. Z.*, **277**, 148; 1935.

A New Type of Plant Lipochrome

IN continuation of our investigations upon the Algæ[1], we have observed the presence of a peculiar carotenoid in the unsaponifiable fraction of one of the *Cyanophyceæ* (*Myxophyceæ*), namely, *Rivularia nitida*. The pigment, for which we propose the name *myxoxanthin*, crystallises from ether-methyl alcohol in deep copper-coloured needles, m.p. 117°–118° (uncorr.), and unlike any other phytocarotenoid hitherto isolated, exhibits only one absorption band, having its head at 488–490 mμ in carbon disulphide. In this respect myxoxanthin resembles the Crustacean pigment astacene[2]; but unlike the latter, it has no acidic properties and is completely epiphasic when subjected to the Kraus partition between methyl alcohol and light petroleum. Its failure to yield a sodium salt precludes the possibility of its being hæmatochrome, which pigment is reputed to exist in certain Algæ and is likewise stated to possess only a single absorption band[3].

We have failed to detect the presence of any hypophasic xanthophylls in *Rivularia nitida*, and the absence of these is, so far as we are aware, unique in plant life, although we have found that *Trentepohlia aurea*, a member of the *Chlorophyceæ*, contains only a minute amount of hypophasic xanthophylls, the yellow colour of the plant being due almost wholly to its high β-carotene content. We are at present engaged in collecting a larger amount of *Rivularia nitida* with a view to a closer characterisation of the new pigment.

I. M. HEILBRON.
B. LYTHGOE.
R. F. PHIPERS.

Chemical Department,
University,
Manchester.
Nov. 28.

[1] Heilbron, Phipers and Wright, NATURE, **133**, 419; 1934. *J. Chem. Soc.*, 1572; 1935. Heilbron and Phipers, *Biochem. J.*, **29**, 1369; 1935. Heilbron, Parry and Phipers, *Biochem. J.*, **29**, 1376, 1382; 1935.
[2] Kuhn and Lederer, *Berichte*, **66**, 488; 1933.
[3] Kylin, *Z. phys. Chem.*, **166**, 39; 1927.

Structure of the Proboscis in Blood-sucking Diptera

In his letter in NATURE[1], Dr. S. K. Sen still upholds the view, which I have criticised[2], that the salivary duct of *Stomoxys calcitrans* terminates at the base of the hypopharynx, the lumen of the latter being a groove running centrally to near its tip.

The hypopharynx (*h.*) of Diptera is formed by an external and an internal tube. The external tube or the external wall of the hypopharynx of *S. calcitrans* (*e.t.*) is formed by the evagination of the floor of the mouth-cavity and is crescent-shaped in transverse sections (Fig. 1). The internal tube (*s.d.*) represents the elongated anterior portion of the common salivary duct and is rounded. Even in *Culicoides*, where the hypopharynx is partly guttered, the part of the salivary duct forming this gutter extends to near the tip of the hypopharynx.

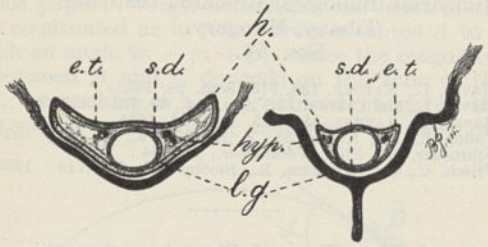


FIG. 1.

What Dr. S. K. Sen has named hypopharynx in his drawing (No. 2) of the transverse section of the proboscis of *S. calcitrans*[3], is actually the most anterior part of the hyoid. His section was evidently cut posteriorly to the base of the hypopharynx.

Fig. 1 shows transverse sections of the hypopharynx of *S. calcitrans* cut through the basal and the distal part of this organ respectively. The drawings also show the position of the hypopharynx in the labial gutter (*l.g.*) and the hypodermis (*hyp.*) occupying the space between the salivary duct (*s.d.*) and the external wall (*e.t.*). In these drawings I have intentionally not shown the theca of the labium, which lies ventrally to the labial gutter, nor the labrum-epipharynx, which lies dorsally to the hypopharynx.

B. JOBLING.

Wellcome Entomological Field Laboratories,
Claremont, Esher, Surrey.

[1] NATURE, **136**, 479, Sept. 21, 1935.
[2] NATURE, **136**, 145, July 27, 1935.
[3] NATURE, **135**, 915, June 1, 1935.

Surface Structure beneath the Pacific

In a letter in NATURE of November 2, p.723, it is stated by Mr. H. F. Baird, acting director of Apia Observatory, that I have found from the velocities of seismic surface waves evidence of the existence of a layer of granite some 10 km. thick below the Pacific Ocean. This statement, based on an abstract only of my paper, is liable to be quite misleading. One extract from the actual paper will make the position clear: "Our ignorance of the structure of the Pacific floor gives no ground for applying the theory of a double surface-layer; it might be worth applying a single layer theory if we had any idea of the properties of that layer. The order of magnitude of the thickness of an equivalent single layer of granite can be found. . . ." If that layer happens to be granite, then the theory gives 10 km. with fair accuracy; if diorite, the thickness is about 16 km.

Independent evidence of the nature of the Pacific floor is badly needed, and it is important that Mr. Baird should have found some evidence of upper and "intermediate" layers from the records of earthquakes that occurred near Samoa. Some years back I endeavoured to trace pulses analogous to P_g, S_g, P^* or S^* in the Suva and Apia readings recorded in the "International Seismological Summary", but without success. A network of seismological stations on some of the Pacific islands, even if established for a limited period of a few years, would give valuable information concerning the structure of the earth's crust beneath the Pacific Ocean.

R. STONELEY.

65 Barton Road,
Cambridge.
Nov. 19.

Electrical Moments of *p*-Quinone and Related Compounds

A DETERMINATION of the electric dipole moment of *p*-benzoquinone in benzene solution by Hassel and Naeshagen[1] gave the value of 0·67 D (D = 10^{-18} E.S.U.). Since *p*-quinone is usually assigned a symmetrical planar structure which should have zero moment, a further investigation of this anomaly was undertaken. The re-measurement confirmed Hassel and Naeshagen's value, and the work was extended to similar compounds with the following results:

Compound	Solvent	Temp.	P_{A+O}	μ
p-Benzoquinone	Benzene	25·0° C.	8·9 c.c.	0·65
,,	Carbon tetrachloride	,,	9·6 ,,	0·68
,,	*n*-Hexane	40·0° C.	8·6 ,,	0·66
2 : 5 Dimethyl-1 : 4 quinone	Benzene	25·0° C.	9·4 ,,	0·68
2 : 5 Dichloro-1 : 4 quinone	,,	,,	8·8 ,,	0·64
Tetramethyl-*cyclo*butane-1 : 3-dione	,,	,,	11·0 ,,	0·73

The possibility of polar impurities being present can definitely be ruled out, since different specimens prepared or purified by different methods gave identical results. As regards a solvent effect, the values for *p*-quinone in benzene, carbon tetrachloride and *n*-hexane are identical within experimental error, and so if the moment is to be attributed to a solvent effect, it cannot be a specific effect of one solvent.

The construction of a model for *p*-quinone indicated that the molecule was not nearly as rigid as the graphic formula would lead one to expect, only a small force being required to distort the molecule into a multiplanar configuration by simultaneous rotation about the four single bonds.

If a strain of 10° in the carbon angle is produced by an increase in energy of 750 cal. per gram molecule[2], it follows that thermal energy at ordinary temperatures would be far more than sufficient to cause the observed moment for *p*-quinone. Pauling and Sherman[3] have calculated the resonance energy of *p*-quinone, and find the large value of 13,000 calories, and it is probably this high resonance energy which tends to prevent the above type of oscillation in the quinone molecule.

The moments observed for 2 : 5 dimethyl- and 2 : 5 dichloro-*p*-quinone, being the same as that of *p*-quinone itself, offer a serious objection to the flexibility theory. The theory was further tested by measuring the moment of tetramethyl-*cyclo*butane-1 : 3-dione, where, owing to the large strain already present in the four-membered ring, a further

distortion of the molecule should not occur. A small moment, however, of the same order of magnitude, is also found in this case. The tetramethyl derivative was used rather than *cyclo*butane-dione itself, since with the latter compound there is the possibility of enolisation.

From these results it would appear that the values observed for the moments are due either to a general effect of the solvent or to an abnormally large atom polarisation. The question can best be settled by measuring the moments of the substances in the vapour state, and this work is being undertaken.

D. Ll. Hammick.
G. C. Hampson.
G. I. Jenkins.

Dyson Perrins Laboratory,
University, Oxford.
Nov. 8.

[1] *Z. phys. Chem.*, B, **6**, 441; 1930.
[2] *Ann. Rep.*, 65; 1932.
[3] *J. Chem. Phys.*, **164**; 1933.

Occurrence of the Dipterocarpaceæ-Dipterocarpoideæ in Africa

In a paper read before the Imperial Botanical Conference last August, which is being published in the forthcoming number of the *Empire Forestry Journal*, I referred to the Monotoideæ as "the only known living African representatives of the family Dipterocarpaceæ".

The Imperial Forestry Institute has now received herbarium material of a true Dipterocarpoid tree, from Nigeria, where it was found by Mr. J. H. Mackay, assistant conservator of forests, growing in primitive forest. Two further records of a similar species, and from other areas, have now been reported by Dr. Helen Bancroft, who has recently described the structure of true dipterocarp wood found in a fossil condition at Mount Elgon (Kenya-Uganda). Records of similar wood from Italian Somaliland, by Prof. A. Chiarugi, of Pisa, have indicated that the sub-family Dipterocarpoideæ was well represented in Africa in Tertiary times.

The discovery of living members of the Dipterocarpoideæ, a sub-family noted for its very valuable timbers, opens up further possibilities, from the practical point of view, with regard to the utilisation and development of tropical African forest areas. Academically, it adds further evidence of an inter-relationship of African-Asiatic types which indicates that in some earlier period there has been a closer connexion between Africa and the Indo-Malayan region, to which I referred in my paper.

J. Burtt Davy.

Imperial Forestry Institute,
University, Oxford.
Dec. 3.

Points from Foregoing Letters

In order to increase the usefulness of herbarium material, and to enable investigators to ascertain not only the range of variation of certain species but also the comparative frequency of different variants, Dr. E. Anderson and Dr. W. B. Turrill recommend that, in addition to the ordinary herbarium material, a carefully selected random sample consisting of 25–50 specimens of some critical part of the plant (such as leaf or seed) should be collected.

The late Sir Richard Glazebrook directs attention to the fact that not only the electrical and magnetic constants μ, K and A, but also many other coefficients used in physics, such as those of compressibility or rigidity, Young's modulus and Joule's equivalent, are in fact ratios between two different methods of measuring force, or energy, in terms of dynamical ('absolute') units.

Drs. F. Bloch and C. Møller have estimated the rate of transition of a hydrogen atom into a neutron, from the theory of Fermi, which allows the formation of a neutron by the combination of a proton with an electron plus a neutrino. They conclude that the transformation of protons into neutrons could only occur by bombardment with electrons of high energy.

Dr. J. Brentano discusses the conditions determining the intensity of X-ray reflections from crystal lattices. He suggests that the technique for obtaining X-ray powder patterns described in a recent letter by Messrs. Stephen and Barnes can be fully accounted for by the general conditions of focusing, which form the basis of his flat layer method previously published.

The lattice constants of zinc oxide films are found by Mr. V. E. Cosslett, using electron diffraction methods, to vary from 3·234 A., immediately after formation from a zinc melt, to 3·279 A. eighteen months later. The latter appeared to be a limiting value. The lattice constant of gold films remained the same over this time, showing that experimental conditions were unchanged. It is, therefore, inadvisable to use such oxide films as standards in electron diffraction work.

Injections of ascorbic acid (vitamin C) into tomato plants are found by László Havas to increase the size of the tumours produced in those plants by *Bacillus tumefaciens*. Mr. Havas recently described similar effects obtained with sex hormones.

A new pigment, myxoxanthin, has been extracted by Prof. I. M. Heilbron, B. Lythgoe and R. F. Phipers from *Rivularia nitida*, one of the blue-green algæ. The new pigment belongs to the carotene series, but unlike other plant pigments of that nature it has a single absorption band in carbon disulphide solution (maximum at 4880–4900 A.), and resembles in this respect the pigment astacene obtained from crustacea.

If we had independent knowledge of the composition of the sub-Pacific crust, observations of the surface waves of earthquakes would enable the thickness to be calculated. Dr. R. Stoneley, in commenting on a letter by Mr. H. F. Baird (Nature, Nov. 2, p. 723), points out that valuable information about the Pacific floor could be obtained if a number of seismological stations were established on Pacific islands.

D. Ll. Hammick, G. C. Hampson and G. I. Jenkins have found that *p*-benzoquinone, its symmetrically substituted derivatives and tetramethyl-*cyclo*butane – 1 : 3-dione all have small but finite electrical moments when measured by the solution method. This is anomalous in view of the symmetrical structure usually assigned to these compounds and may be due to a general effect of the solvent or to an abnormally large atom polarisation.

Research Items

Norwich 'Woodhenge'

SOME further results of the excavation of the recently discovered 'Woodhenge' (see NATURE of September 7, p. 365) are described by Mr. J. G. D. Clark in *Antiquity* of December. When excavation began in August last, two rings were observable, of which the inner was interrupted by what was evidently a causeway; but the central area showed no signs of post-holes or other features. An eleven foot section was cut from outside the circle, this running for a distance of 100 ft. in all. Both the inner and the outer ditch proved to be shallow relatively to their width, and between them were the remains of a bank, much ploughed down. The outer ditch produced some third century Romano-British sherds from above a sterile layer overlying the primary silting. The inner ditch produced stratigraphical evidence of importance. Below three feet of infilling, ploughed in when chalk was used to marl the ground, down to the bottom of a black zone, were quantities of early iron age pottery, yet to be examined, and a strong admixture of Romano-British material, which appears to date from the third century of the Christian era. Evidently the iron age levels had been disturbed in Romano-British times. Below the iron age level was a sterile zone of primary infilling on a thin charcoal stratum on the floor of the ditch. This produced sixteen sherds of pottery and three or four 'crumbs' of the same ware, resembling 'beaker' on the inside and decorated in rusticated finger-nail style on the outer surface. The central area was stripped to the gravel and sand. There proved to be eight, not nine, post-holes, the timber part of the monument being on the horse-shoe plan, resembling the arrangement of the inner horse-shoe of blue-stones and of the trilithons at Stonehenge. The set of the ramps of the post-holes points to the erection of the timber uprights before the construction of the inner ditch.

Wild Cat and Domestic Cat

As the result of the measurement of a large number of Scottish wild cats (*Felis sylvestris*), including 42 specimens received complete in the flesh and 70 skulls, John C. Kirk publishes a useful comparison between the wild and domestic cats (*Scottish Naturalist*, 161; 1935). Domestic cats which have run wild soon assume the characters of the wild race, developing longer and coarser fur, longer limb-bones and larger teeth, and after two or three generations in a wild state would be scarcely distinguishable from the true wild cats, and the author thinks that probably there is a certain amount of domestic blood in the wild cat of the present day. In spite of these difficulties and of the fact that no single feature in the skull of the wild cat may not occasionally be duplicated in the domestic cat, the author gives a series of distinguishing marks which can generally be relied upon. On the whole, while the lower jaw is more strongly developed and the muscular ridges of the skull are strongest in the wild cat, the bones of the cranium are generally lighter and thinner than in domestic cats. The wild cat has longer limbs, longer and coarser fur, larger teeth, but shorter small intestine (43–51 in. against 58–66 in.).

Light as a Factor in the Growth of Barnacles

A STUDY of the distribution of the common barnacle (*Balanus balanoides*) upon the different sides of the wharf of the Atlantic Biological Station has led Prof. A. Brooker Klugh and Curtis L. Newcombe to correlate the differences with amount of sunlight (*Canadian J. Res.*, 13, 39, Sept. 1935). A significant correspondence was found between the rate of growth of the barnacles and the amount of illumination. Moreover, the difference between the amount of growth at widely separated vertical levels was similar to the difference in areas on the same level where there was wide variation in the amount of illumination.

Zoology of the Voyage of the *Belgica*

Two recent monographs (Expedition Antarctique belge, Resultats du Voyage de la Belgica en 1897–99 sous le Commandement de A. de Gerlache de Gomery. Rapports Scientifiques. Zoologie. Anvers, 1935) deal with the Pycnogonida (by Louis Giltray) and the Oligochæta by (Leon Cĕrnosvitov). There are few pycnogonids, but these are interesting and include a new species of *Nymphon*, *N. gerlachei*, an abyssal form from 460 m. depth, associated with *N. longicoxa*, Hoek, from Banquisi, lat. 71° 5′ S., long. 89° 3′ W. *N. gerlachei* has a very thin body and long thin legs, probably walking on fine mud. Only one specimen was found—a male. The Oligochætes collected by the expedition consist of eight species, all known forms. A new variety of *Chilota corralensis* is described, living under mosses covering rocks and dead leaves from Lapataia, Terra del Fuego. The type is only known from Corral in Chile, and the present variety, var. *belgicæ*, differs from it in several particulars, especially in colour, form of the body and the situation of the genital papillæ. Immature individuals were also found among roots of plants growing on the rocks near a waterfall in the Island of Londonderry.

A New Family of Sawflies and the Genera of the Cephidæ

MR. ROBERT B. BENSON (*Ann. Mag. Nat. Hist.*, (10), 16, Nov. 1935) has erected a new family, Syntexidæ, for a very interesting species of sawfly, *Syntexis libocedrii*, Rohwer. The species is at present only represented by two adult specimens in the United States National Museum and a few larvæ found boring in the wood of the incense cedar (*Libocedrus decurrens*, Wrr.) in California. The family is placed between the Xiphydriidæ and Cephidæ; but it is really very distinct from either, though heretofore included in the Cephidæ. In dealing with the Cephidæ of the world, five new genera are described; one of these, *Athetocephus*, is erected to contain two peculiar species from Madagascar, only the third and fourth known sawflies from that island. Many new characters used in the keys are illustrated in the twenty line drawings by the author. Attention is directed to the fact that the Cephidæ are not an unspecialised family as is generally supposed, but on the contrary, very highly specialised. In some respects, such as in the presence of a marked constriction at the apex of the basal segment of the abdomen, they show an approach to the formation of a propodeum characteristic of the other great sub-order of the Hymenoptera, the Apocrita.

Histology of Sponges

D. A. WEBB (*Quart. J. Micr. Sci.*, 78, Part 1, Oct. 1935) gives in an article of eighteen pages a useful résumé of the literature published since the beginning of 1914 on the histology, cytology and embryology of sponges. The different kinds of cells and the cytoplasmic inclusions are considered, and the second half of the article is devoted to gametogenesis, fertilisation and embryology. It is remarkable that stages in spermatogenesis are so rare, so that this "process still remains rather a mystery". Authors are, however, agreed that the spermatozoa of sponges are of an ordinary filiform type similar to those of most other animals. The transport of the spermatozoon to the oocyte in *Grantia* by means of an intermediary carrier-cell, as first described by Gatenby, has been confirmed by later workers for *Grantia* and *Sycon*, and for *Cliona* and *Reniera*.

Transpiration and Stomata in Desert Plants

THE first paper to be published by the Faculty of Science of the Egyptian University (*Bull. Fac. Science*, 1, Egyptian University, Cairo, 1934) deals with the vexed question of stomatal control of transpiration in desert plants. Earlier work of this nature is reviewed, and comment and criticism made of the lines of attack, methods of investigation and conclusions of the observers. In these present experiments, the investigators, A. H. Nontasir and A. M. Nigaleid, seem to have taken steps to eliminate some of the errors, often included unwittingly in this type of work, and their experiments have been repeated under varying conditions. An interesting modification is made in the relation of relative humidity to water loss—in this case it is the relative humidity *deficit* of the air which is considered in *direct* proportion to evaporation, which seems a much more rational correlation than that of actual humidity to water loss. The general results indicate once again that stomatal control is almost negligible unless the stomatal aperture is almost closed, that under conditions encouraging maximum evaporation the stomata are wide open, and that when such conditions are removed there is still a time lag in stomatal closure. Actually, in most cases, the water content itself is the most effective limiting factor, resistance to water loss increasing rapidly with falling water content, whilst at the same time spine formation and foliage reduction have a protective effect. Very detailed results of the experiments are given, and the paper is accompanied by a good representative list of references.

Hybrids of Tropical Orchids

A VERY interesting review by M. J. Costantin ("Les Hybrides des Orchidées tropicales", *La Nature*, Paris, November 15, 1935) describes the history of orchid culture since Neumann first succeeded in germinating the seed in 1844. Dominy, an assistant to James Veitch, was the first to hybridise two orchids (1856), and from that time, new hybrid plants have appeared in steady succession, until, at the present time, more than four hundred new kinds are described in most years. These hybrids are all fertile, and in some cases, seed can be produced parthenogenetically, following the mere stimulus of pollen upon the stigma. The account centres round the work of Noël Bernard, who introduced the symbiotic method of culture. Seeds were sown upon a sterilised medium which was then inoculated with a pure culture of a fungus, usually a species of *Rhizoctonia*. M. Costantin discountenances the asymbiotic method of culture, where seeds are grown on sterilised medium, containing glucose, with no added fungus. This is, perhaps, a little anomalous, for modern asymbiotic culture gives 100 per cent germination, and is used by all large orchid growers.

Horizontal Distortion of the Earth's Crust near Tokyo

IN the enclosure of the Tokyo Astronomical Observatory at Mitaka, five geodetic base-lines, each about 100 metres in length, are arranged so as to form a rhombus and its north-south diagonal. Once a year, on an average, since 1916, the lines have been measured, and the results show a relative increase or decrease in the area of the rhombus of the order 10^{-5}. The yearly variations have been discussed by Mr. C. Tsuboi (*Bull. Earthq. Res. Inst.*, 13, 558–561; 1935), and they are compared with those of the mean annual height of the sea-level at Aburatubo, a mareograph station about thirty-seven miles south of Mitaka. Though the latter variations are partly due to meteorological conditions over the adjoining sea, it is remarkable how similar are the curves representing the two variations, an increase in the area of the rhombus corresponding with an upheaval of the sea-coast. It thus seems probable, as Mr. Tsuboi concludes, that the changes in the area of the Mitaka rhombus are not of local origin, but correspond with larger crust-deformations prevailing over at least the southern half of the Kwanto district.

Flood Regimen of the River Garonne

IN a studiously analytical monograph on the regimen of the Garonne, reprinted from *La Revue Géographique des Pyrénées et du Sud-Ouest* (April–July 1935), M. Maurice Pardé, professor in the School of Hydraulic Engineering of the University of Grenoble, has made an important contribution to the literature on river characteristics and discharges. The Garonne floods, says Prof. Pardé, illustrate most vividly the complex character of the river. In no other fluvial basin in France, otherwise than exceptionally, do floods rise to so great heights. There exist, with several variations, three distinct types of inundation: Oceanic-Pyreneean, Oceanic-Classic and Mediterranean, as compared with a single type for the Seine and the Po, two types for the Loire, three for the Rhine and four for the Rhone. In reality, the flood system is more complex on the Garonne than on the Rhine, since the characteristics of the three types persist in intensity as far as the lower course of the river, while the 'Mediterranean' floods of the Rhine are absorbed in Lake Constance and the summer Alpine floods lose their violence below the Neckar. Alone in Europe, the Rhone and the Danube exhibit a variety of inundations comparable with those of the Garonne basin. The Oceanic-Pyreneean floods rank first in intensity, and occur at all seasons, though rarely in advanced summer or at the commencement of autumn (September, 1772). It is in May and June that they attain their greatest frequency and gravity. The main cause is heavy rainfall on the northern slopes of the Pyrenees and of the Montagne Noir, produced by winds from a north-west or northerly direction. The Oceanic-Classic type of flood, mostly deleterious

in the lower Garonne, occurs chiefly in winter; simultaneously with the Garonne, this type frequently afflicts several other important watercourses in western Europe, primarily the Dordogne, the Vienne and the lower Loire, then the Seine, the upper Rhone, the Meuse, the Rhine, etc. Such floods originate regularly in the passage of an atmospheric perturbation over France, while an anticyclone, essentially convex towards the north-east, is stationed on the south-west of the Iberian peninsula. The 'Mediterranean' type of flood is produced by torrential precipitation induced by the south-east wind in the eastern part of the basin. The severity of the Garonne inundations is remarkable.

Infra-Red Absorption of Crystals

R. B. BARNES, R. R. Brattain and F. Seitz (*Phys. Rev.*, Oct. 1) have elaborated a theory of the infra-red absorption of cubic crystals, and have tried to correlate it with new experimental work on MgO. On the classical theory, a cubic crystal has only one characteristic absorption frequency, corresponding to a vibration in which like ions move together and unlike ions 180° out of phase. The new theory handles the crystal as a system of interacting particles arranged on a lattice, and a general potential function of interaction is set up. The existence of anharmonic terms in the potential function is supposed to modify the selection rules in such a way that a complicated secondary structure is superposed on the single absorption frequency. The experiments were made on crystals of MgO prepared in the electric furnace on evaporated films and on powder. They show the existence of a secondary structure, but the low resolving power and the fact that the crystals were at room temperature, this causing broadening of the lines, make a detailed comparison with theory impossible. Further experiments are being carried out.

Quantum Theory, Geometry and Relativity

THE quantum theory, with its principle of uncertainty, seems to show that ordinary geometry is not applicable to microscopic space. In a series of interesting papers by T. Hosokawa, K. Morinaga, T. Sibata, Y. Mimura and T. Iwatsuki (*J. Sci. Hiroshima Univ., A*, 5, 141, 151, 189 and 205; 1935), a new 'wave geometry' is discussed, which is chosen so as to conform with quantum theory. Its definitions are rather startling at first sight, as they are expressed in terms of matrices and a wave function which is a solution of a generalised Dirac wave equation. From these definitions an extensive theory is developed, more or less on the lines of the ordinary tensor calculus, giving results which are taken as the starting point of a new theory of relativity. It is claimed that this gives Einstein's law of gravitation in a natural manner. Another consequence of the new theory is the existence of gravitational waves, and equations are obtained which, it is hoped, will prove as useful in gravitational theory as are Maxwell's in ordinary electromagnetic theory. In short, the authors are attempting to go beyond the ordinary unified field theories, which leave out quantum theory, and to set up a universal scheme to embrace all physical theories. There are several points that have not yet been fully worked out, and it is too soon to say whether the attempt has been successful; but it certainly opens up what appears to be a very promising line of inquiry.

Diesel Fuel Research

RESEARCHES on Diesel fuels are being carried out by Prof. P. H. Schweitzer and T. B. Hetzel in the Pennsylvanian State College laboratories on oils for Diesel engines (Science Service, Washington, D.C.). The sources of petrol are continually diminishing, and unless it becomes possible to produce petrol cheaply from coal, we must anticipate to look forward to the day when motor-cars will be run with cheap Diesel fuels. Petrol 'knock' is due to the petrol starting to burn evenly in the cylinder, and then suddenly exploding, causing a 'knock'. For smooth running, it is necessary to retard the burning of the petrol, and this can be done by lead tetraethyl. In Diesel engines combustion is not started by sparking plugs but by spontaneous ignition due to the compression of the fuel, its temperature rising above that needed for explosion. If too much fuel explodes at once, there is a knock, and the way to stop it is to make the fuel burn as soon as possible after entering the cylinder, the remedy being to speed up combustion. Schweitzer and Hetzel have developed an ignition lag indicator which will be useful for testing the relative values of Diesel fuels. They employ the principle of a phonograph pick-up device in conjunction with a radio loud-speaker. The fuels are compared for performance over a wide range of compression values and the results found can be usefully applied in practice in special cases.

Preservation of Mine Timber

THE third of the series of Forest Products Research Records is entitled "Experiments on the Preservation of Mine Timber" by Messrs. J. Bryan and N. A. Richardson (H.M. Stationery Office, 1935). The timber used annually in the mines of Great Britain is valued at £6,000,000; it is estimated, however, that less than two per cent receives any preservative treatment. Losses are due to wood-destroying fungi. To some extent the reason why the non-expert is not so readily converted to the idea of preservative treatment is due to the fact that the incidence of attack is variable, some mines being quite free from infestation of this type. When conditions are favourable, such as in humid shallow pits, decay is very rapid, and the timber is short-lived if not treated with a preservative. The cost of timber is consequently high in such situations, and here preservative treatment would probably reduce running expenses of the pit. As is pointed out, the failure of mine timbers may often be due to incipient decay due to fungal attack, rather than to lack of individual strength. Thus preservative treatment may lead to greater safety in the mine. The note explains that experiments were inaugurated at two pits, the Langton Pit, Pinxton, near Nottingham, and the Woolmet Pit at Portobello near Edinburgh. The experiments were carried out with imported and home-grown Scots pine pit props which were treated at the pit-heads with solutions of sodium chloride (common salt), zinc chloride, sodium fluoride, Wolman salts, and placed in workings at about 800 ft. below the surface. In the Pinxton Collieries creosoted props were also used. The results attained so far after 4½–5 years inspection are considered satisfactory—the more expensive preservatives, namely, creosote, Wolman's salts and sodium fluoride, being the best.

Chemistry of the Vitamins

VITAMIN A

SINCE vitamin A has not yet been isolated, methods for the production of highly active concentrates are of interest. A method of comparing the richness in vitamin A of various products is the so-called 'blue value'. This is the number of blue units read with a Lovibond tintometer for 0·04 gm. of solid dissolved in anhydrous chloroform immediately after reaction with a solution of antimony trichloride in chloroform. Previous workers have prepared vitamin A concentrates by vacuum distillation, and very active materials had blue values of about 100,000—usually lower.

An adsorption method of concentration has now been investigated by H. N. Holmes, H. Cassidy, R. S. Manly and E. R. Hartzler[1]. The non-saponifiable portion of halibut liver oil was obtained in solution in pentane, the cholesterol and other impurities were frozen out by cooling for 7–10 days in a bath of solid carbon dioxide and alcohol, and filtered off under pressure, or by suction, through carbon dioxide snow. Solutions of 45,000–50,000, in one case 60,000, blue values were thus obtained. Filtration through an absorption column of Norit oxygen-freed charcoal, with special precautions to prevent oxidation, followed by a column of a new type of magnesia prepared from the precipitated hydroxide, gave blue values of 100,000–140,000, so that a concentrate of vitamin A at least 40 per cent more potent than any previously recorded was obtained.

VITAMIN B_1

By cleavage of vitamin B_1 with sulphite, a basic substance, C_6H_9NSO, is obtained as a colourless oil giving crystalline hydrochloride, chloroplatinate, picrate and picrolonate. E. R. Buchman, R. R. Williams and J. C. Keresztesy[2] now find that this substance gives on oxidation an acid with the formula $C_4H_4NS.COOH$, which is identical with one obtained by Windaus directly from the vitamin. The basic substance is regarded as a tertiary heterocyclic base with a β-hydroxyethyl side chain, $C_4H_4NS.CH_2CH_2OH$, and the vitamin itself as a quaternary salt of the base.

The presence of a quaternary nitrogen in the vitamin B_1 has been confirmed by electrometric titration with alkali by R. R. Williams and A. E. Ruehle[3], when the presence of a moderately strong basic nitrogen was revealed, too strong for a tertiary base, but not strong enough for a true quaternary base. The basic cleavage product, C_6H_9NSO, behaved as a typical tertiary base, but its methiodide closely resembled the vitamin not only in basic strength but also in exhibiting an unusual pseudo-basic behaviour, both substances requiring an additional equivalent of alkali for complete liberation of the base.

It had been suggested that the vitamin contains a thiazole nucleus, and titrations of some thiazole derivatives gave similar results. The conclusion is reached that vitamin B_1 contains two basic groups, one of which is of the same order of strength as the nitrogen in the quaternary salt of its basic cleavage product and in 4-methylthiazole ethiodide. This feature of the structural formula for vitamin B proposed by Williams[4] is thus confirmed.

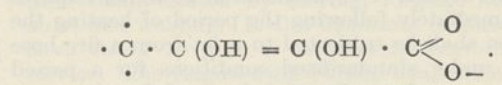
In view of the presence of sulphur in the vitamin B_1 molecule, and the suggestion that it contains a thiazole nucleus, it was obviously of interest to examine the mode of combination of the sulphur by methods recently developed for the study of sulphur in proteins, especially the behaviour towards alkali plumbite and bromine water. The vitamin B_1 and its basic cleavage product behaved very differently with both reagents, according to H. T. Clarke and S. Gurin[5], the vitamin giving lead sulphide relatively rapidly with plumbite reagent and the cleavage product scarcely reacting, and the latter is largely oxidised to sulphuric acid by bromine water under conditions in which the vitamin remains almost unchanged.

These results indicate that the sulphur atom in the base is linked to two carbon atoms in a structure in which the carbon groupings are more susceptible to oxidative attack than is sulphur. The acid obtained by Windaus, $C_6H_5O_2NS$ (see above), yields lead sulphide with plumbite, yet is resistant to oxidation with nitric acid. This is characteristic of the thiazole nucleus, and it is now shown, by synthesis, that the acid is 4-methylthiazole 5-carboxylic acid. The basic cleavage product is shown to be 4-methyl 5-β-hydroxyethylthiazole, which has been synthesised. Titrations of vitamin hydrochloride and of 4-methyl thiazole ethiodide indicate that the last of the three equivalents of alkali used, reacting about *p*H9, opens the thiazole ring with formation of a sulphydryl compound.

Examination of absorption spectra by A. E. Ruehle[6] shows that the ultra-violet absorption of the basic cleavage product of vitamin B_1 is not only similar to that of the thiazoles, but its derivatives also exhibit absorption similar to that of corresponding thiazole derivatives.

VITAMIN C

The titration curves and dissociation constants of *l*-ascorbic acid (vitamin C) were determined by Birch and Harris[7], who found at 16°–18° the values $pK_{a_1} = 4{\cdot}17$ and $pK_{a_2} = 11{\cdot}57$. A determination at 22°–23° by W. D. Kumler and T. C. Daniels[8] is now shown to give the values $pK_{a_1} = 4{\cdot}12$ and $pK_{a_2} = 11{\cdot}51$, in very good agreement. The hydrogen electrode was used. Titration curves for *l*-ascorbic acid and diethyl dihydroxymaleate in alcohol water solution were also determined, in view of the suggested formula for *l*-ascorbic acid in which this compound has no carboxyl group, but contains a grouping



Evidence that a structure of this type may give rise to relatively strong acid properties has been cited.

The β-ketonic ester, diethyldihydroxymaleate, contains this structure, and a consideration of its groups shows that it should be a stronger acid than *l*-ascorbic acid. Actually *l*-ascorbic acid is much

stronger, its first dissociation constant being a thousand times as great as that of the other compound. The apparent inability of the enolised α-hydroxy-β-ketonic ester type of compound to account for the acid properties of *l*-ascorbic acid suggests that some other grouping is responsible for its large first dissociation constant. It may, however, be suggested that the use of the ordinary hydrogen electrode with a compound containing a double bond requires further investigation.

[1] *J. Amer. Chem. Soc.*, **57**, 1990; 1935.
[2] *J. Amer. Chem. Soc.*, **57**, 1849; 1935.
[3] *J. Amer. Chem. Soc.*, **57**, 1856; 1935.
[4] *J. Amer. Chem. Soc.*, **57**, 229; 1935.
[5] *J. Amer. Chem. Soc.*, **57**, 1876; 1935.
[6] *J. Amer. Chem. Soc.*, **57**, 1887; 1935.
[7] *Biochem. J.*, **27**, 595; 1933.
[8] *J. Amer. Chem. Soc.*, **57**, 1929; 1935.

Fire Resistance of Buildings

A LABORATORY of an unusual kind was opened by H.R.H. the Duke of Kent at the end of last month. This is the Fire Testing Station erected at Elstree by the Fire Offices Committee, an organisation representing the tariff insurance companies, for the purpose of investigating the resistance to fire of building materials and elements of structure.

The need of such an institution has been apparent for some years, and has been steadily growing. Little enough is known of the protection against fire afforded by the traditional types of building material, and still less of the many new types which have appeared in recent years. This uncertainty is reflected in the building codes issued by local authorities, which, so far as provisions against fire are concerned, are often contradictory.

A good deal of research has been carried out abroad, notably at the Underwriters Laboratory at Chicago; and in Great Britain, before and during the Great War, the now defunct British Fire Prevention Committee investigated certain aspects of the problem. But the first attempt in Great Britain to put the whole subject on a sound basis was taken by the British Standards Institution in 1932. In this year, it published "Definitions for the Fire Resistance, Incombustibility and Non-Inflammability of Building Materials and Structures" (B.S.S. No. 476), which laid down a test procedure for assessing the fire resistance of structural elements by means of a standard test upon full-sized specimens.

From the evidence of actual fires and from demonstration tests, it has been established that the temperature within a fiercely burning building rises rapidly to about 1,500° F. and thereafter more slowly up to a maximum of about 2,000° F. The standard test provides that specimens shall be heated in accordance with a time-temperature curve which approximates to that of recorded conflagrations; furnace temperatures of 1,000° F., 1,700° F. and 2,300° F. are required at the expiration of 5 minutes, 1 hour and 8 hours respectively from the beginning of the test. It is also necessary to take account of the effect of water from fire hoses impinging on a heated structure. The specification therefore requires that immediately following the period of heating the specimen shall be subjected to a jet from a fire hose applied under standardised conditions for a period equal to one minute for each hour of fire exposure. In the case of load-bearing structures, it is further provided that a load equal to 1½ times the working load shall be maintained on the specimen throughout the whole period of the test. In certain cases, the load must be re-applied forty-eight hours after the completion of firing.

According to the period which elapses between the beginning of the test and the failure of the specimen, the specimen is classified into one of five grades, the highest being represented by a fire-resistance period of six hours and the lowest by one of half an hour.

In the case of walls, floors and other elements which function as separating structures, the specimen is heated on one side only, and failure is indicated either by a temperature rise on the unexposed face of more than 250° F., or by the development of cracks through which flame can pass, or by collapse under load. Columns and other elements which serve only as load bearers are heated on all sides and are said to have failed when collapse under load occurs.

By issuing this specification, the British Standards Institution not only provided a clear basis for the study of the subject, but also directed attention to the absence of adequate testing facilities. As a result of a conference between interested bodies, the Fire Offices Committee undertook to provide these facilities and the Department of Scientific and Industrial Research to assist in the solution of technical problems.

The Testing Station at Elstree consists of two buildings: one contains equipment for testing the fire-resistance of structural elements; in the other, provision is made for continuing the work on sprinklers, fire-extinguishers and other appliances which has hitherto been carried out by the Committee at Manchester. For testing structural elements, three units have been provided—for walls, columns and floors respectively. In each case, heat is provided by a gas-burning furnace operated electrically from a control room adjoining and overlooking the main building. The gas-air mixture is fed to the burners through 'inspirators' which automatically maintain a constant proportion of the two ingredients at all pressures; the air is supplied at a maximum pressure of approximately 15 in. of water and the gas at the normal pressure of the mains. The fuel supplied to different parts of the furnace is controlled separately, with the view of maintaining a uniform temperature over the whole area of the specimen.

Both furnace and specimen temperatures are recorded by thermocouples connected to instruments located in the control room. Platinum rhodium – platinum couples are used for furnace temperatures, and chromel – alumel or copper – constantan couples for specimen temperatures. The leads from each separate equipment pass through a bus-board mounted on the instrument panel, by means of which a quick change-over may be effected from one furnace to another.

In the wall and column units, the load is applied to the specimen by mounting it in a heavy, built-up steel frame designed so that an upward thrust can be given to the bottom beam of the frame by means of hydraulic rams. The rams are operated on a maximum oil pressure of two tons per square inch, the oil being supplied by an electric pump and the load being recorded by a pendulum dynamometer in the control room. These loading frames have a maximum capacity of 500 tons. They stand in pits in the floor of the building, and the furnaces used in conjunction with them are built on wheels so that they can be moved away for the water test. In the floor testing unit, the furnace is fixed and the specimen is lifted away for the water test by a 30-ton travelling electric crane.

The essential aim of the Station is to provide the means of carrying out tests, as rapidly and economically as possible, on the basis of the standard specification. A considerable amount of work upon traditional materials is required, but tests of new types will be run concurrently.

Arrangements have been made whereby the facilities of the Station will be available to the Department of Scientific and Industrial Research, through its Building Research Station, both for carrying out a general programme of research into the fire resistance of traditional materials, and for conducting tests on behalf of manufacturers in accordance with a fixed schedule of charges, when a certificate of performance is required. It is hoped that the industry will take full advantage of the opportunity which now occurs to have the fire-resisting properties of its products assessed on a proper basis.

Scientific Research in Transport

NEW LABORATORY OF THE LONDON, MIDLAND AND SCOTTISH RAILWAY

LORD RUTHERFORD opened the new research laboratory at Derby of the L.M.S. Railway on December 10 (see NATURE, December 14, p. 949).

A distinguished party of guests travelled from St. Pancras by special train, the engine of which was named "Lord Rutherford of Nelson" by Lord Rutherford's small grandson, Pat Fowler, and at Derby luncheon was served on the train. Speeches made during luncheon by Sir Josiah Stamp and Lord Rutherford were relayed to the various cars, and everyone heard excellently. In his speech, the former specially welcomed Sir William Bragg and Sir James Jeans. He recalled that when he was president of the Institute of Transport, he devoted his presidential address to the subject of scientific research in transport and expressed his gratification that some of his dreams have now come true. The days of haphazard and rule of thumb tests are over; the days of controlled and directed experiment under arranged conditions have fully arrived. At the same time, he said, "I would like to stress the fact that we are not trying in this new laboratory to supersede or to rival scientific effort in all directions". The company is still extending its use of outside facilities in connexion with the Department of Scientific and Industrial Research.

Lord Rutherford, in declaring the new laboratory open, said that the L.M.S. is described as a public utility company; but it is more like a State within a State, as it has a gross revenue of nearly seventy millions and its own sea, land and air forces all organised for the most efficient service to the community. On the map, the railway appears to be not merely the backbone but rather the whole vertebrate system of Great Britain. Lord Rutherford said he is convinced that there is scarcely a single unit, whether of machinery or lay-out or even of organisation, that cannot be improved for its purpose by the application of scientific research. But even when valuable results are obtained, there still remains the serious difficulty of introducing them into this great organisation, which has developed over long years a successful routine. To obtain the best results from a laboratory such as the one at Derby, it is essential to develop mutual respect and understanding between the scientific man and the practical man. He expressed the hope that the officers and staff of the Railway will take the greatest interest in the new laboratory and utilise its services to help solve their problems.

Lord Rutherford then declared the laboratory open, and the staff and visitors were divided into groups and shown over it, some of them also inspecting the wagon and locomotive works.

The L.M.S. Railway is probably the largest commercial undertaking in the world. It has an authorised capital of 439 million pounds and gives employment to 223,000 persons. In addition to 7,000 miles of line open to traffic, it possesses 8,000 locomotives, hundreds of thousands of vehicles, 45 steamers and 31 hotels. In addition, it conducts several extensive manufacturing undertakings in connexion with its transport business. In 1930, Sir Harold Hartley was appointed vice-president and director of scientific research. In 1932, the chemical, paint, metallurgical and textile laboratories were formed into a research department. The effect of the completion of the new laboratory is to concentrate in one building the various research sections. In addition to possessing a large staff of specialists to deal with the various problems which are continually arising, the department utilises to the fullest extent the research organisation of the Department of Scientific and Industrial Research. It is also a member of six research associations, and allocates certain problems to research laboratories at the universities.

The Metallurgical Section is concerned with investigations relating to the selection of metals and their manipulation by casting, forging, heat treatment and welding. It also examines materials which have failed to give a satisfactory performance in service. The Engineering Section deals with research on the design and performance of engineering details of machines and structures. It studies aerodynamical problems connected with the air resistance of trains, with wind pressures, ventilation systems and so on. The Textile Section is responsible for the inspection and testing of the various textile materials purchased by the Company, and for drawing up specifications

controlling their quality. This laboratory makes about eight thousand tests every year. The Paint Section specifies and tests all kind of paint materials. It is also concerned with the routine control of the manufacture of paint- and varnish-cleaning agents. In the constant-temperature and humidity room the nature of all textiles is closely examined. A humidity control apparatus maintains constant conditions of 75° F. and 66 per cent relative humidity. This is essential, as the properties of textiles vary largely with temperature and humidity.

In the workshop, special precautions have been taken to prevent the transmission of vibration. In some of the rooms accelerated tests are carried out. For example, in the paint exposure laboratory, by the use of the 'weatherometer', results can be obtained in five weeks which with outdoor exposure alone would have taken twelve months. At the moment, more than a thousand outdoor exposures are in progress. Visitors were impressed by the practical nature of the tests, and the great economic value of the results to the Company.

Energy-Output of the Coal-Miner

IN a paper read before the Institution of Civil Engineers on December 13, Prof. Kenneth N. Moss discussed the energy-output of the coal miner.

The object of the first part of the paper was to show that the performance of manual work necessitates a food-input in excess of the energy-output. Thus if it is required to maintain a high work-output from men engaged in manual work, the engineer in charge must satisfy himself that the calorie-value of their food-input is adequate for the purpose.

Some years ago, Prof. Moss determined the calorie-value of the daily food-input of sixty colliers, and found that the average was a little more than 4,700 Cal. The average oxygen consumption per minute throughout the working shift on the coal-face for twelve colliers was found to be 1,333 c.c., which, after deducting the average oxygen basal resting-rate of 235 c.c. of oxygen a minute, was found to be equivalent to 16,950 ft.-lb. of energy.

The total energy expended below ground during a 7½-hour shift is about 2,800 Cal., and the energy expended during 24 hours is estimated to be about 4,500 Cal. Thus the calorie-value of the daily food-input of a miner should be 4,750–5,000 Cal., to enable him to do his work without loss of body weight or coal-output. The actual average work-output, assuming the mechanical efficiency of the body to be 25 per cent, was 4,237 ft.-lb. per min. during the time spent on the coal-face.

If a miner has to work or walk in places where he has to stoop a good deal, his energy-output is greatly increased, or in other words, the mechanical efficiency of his body is seriously diminished. Thus if a miner has to work in a stooping position so that his body height is reduced by 40 per cent, his energy-output is increased by 65 per cent. If men have to walk a good distance along low roadways the energy expended may be so great as seriously to affect their work-output in the working place. Alternatively, if men are called upon to walk to their work under such conditions, their food-intake must be increased to enable the extra energy to be expended.

Referring to the physiological aspect of the problem, Prof. Moss said that a miner at work in air at a dry-bulb temperature of 98°–100° F., and a wet-bulb temperature of 85° F., can lose as much as 18·56 lb. of moisture through the sweat-glands and respiratory tract during 5½ hours work. If the work-output below ground is equal to 2,800 Cal., it is necessary, assuming that no heat is lost by radiation and conduction, to evaporate 10·6 lb. of water from the skin to neutralise the heat generated in the body during work. The significance of a high wet-bulb temperature is thus clear.

The drinking of water when at work is essential in order to keep the body-temperature normal, though excessive drinking of water is harmful. The significance of the chloride content of the blood points to an effective remedy for heat-cramp and fatigue ; the addition of 5–10 gm. of sodium chloride to 1 gallon of drinking water will prevent the cramp, and to a great extent the fatigue, which is caused by hard work under trying air-temperature conditions.

Archæological Research in South Africa

ONE of the biggest drawbacks to the proper study of prehistoric archæology in South Africa has been, and still is, the complete absence of a properly worked out and correlated geological background. The advances and recessions of ice sheets during the Quaternary provide this background in Europe, and broadly speaking, the existence of the geological canvas has not only created a great stimulus to research in prehistory generally, but has actually become an essential feature of the proper study of the subject. In South Africa there is unfortunately no such background. Prehistorians will therefore be interested to know that the Directors of the Geological Survey and the Bureau of Archæology of the Union of South Africa have arranged a joint and detailed geological and archæological survey of certain vital sections of the Vaal and Riet River Valleys and their tributaries, with special reference to climatic and other conditions during the Quaternary. These valleys hold the secrets of climatic fluctuations and earth movements that were experienced in post-Pliocene times in South Africa, secrets that may be found to be intimately interrelated with climatic fluctuations and movements in other parts of the world—in East Africa and Europe particularly. If correlation is possible and earth

movements and 'pluvial' and interpluvial conditions here can be satisfactorily correlated with similar conditions in East and Central Africa and with glacial and interglacial conditions in palæarctic regions, we must ultimately be led to a better, if not a proper appreciation of the relative time horizons when men practising similar material cultures appeared on the scene in these continental extremes. The issue is of the greatest moment in that men who made Chelles-like tools are believed to have appeared in Southern Africa during early Pleistocene times, and this new undertaking, sponsored entirely by the State and under strict control, therefore represents the greatest step forward prehistory has known for some time.

The sequence of prehistoric material cultures in South Africa is too well known to need recapitulation here. From the Stellenbosch Culture (Chelles + Clacton types to Acheul + Old Levallois types) through the Fauresmith Culture (La Micoque + Combe Capelle + Levallois types) upwards, the story is complete. All we need is the geological and particularly the climatological background.

Ancient river terraces, stratification and its causes, associated fauna, alluvial deposits, etc., will be examined by geologists and archæologists working in the closest harmony over several hundred square miles, and it is confidently anticipated that this work will lay the foundation for a better, if not a full appreciation of the geological and climatological canvas on which all our pictures of prehistoric man in South Africa must be drawn. This work should undoubtedly lead us to a better appreciation of possible and more far-reaching correlations with climatic fluctuations and earth movements in other parts of the world, and so to the relative dating of the appearance of particular lithicultural horizons in widely separated areas.

The value of the Vaal River was recently brought out by Prof. Van Riet Lowe, director of the Bureau of Archæology, in the article "Implementiferous Gravels of the Vaal River at Riverview Estates" in NATURE of July 13, 1935 (pp. 53–56). Similar conditions, Prof. Van Riet Lowe assures us, exist over many hundreds of miles along this amazingly rich valley.

The areas to be attacked immediately are those that will be inundated after the completion of the huge dams at present in course of erection at various sections across these rivers.

Fieldwork is being started immediately, and it is anticipated that it will continue for at least eight months. Two geologists and an archæologist are taking the field at once. The major issue is undoubtedly geological and this side of the problem is therefore being stressed.

Study of Nutrition

INQUIRY BY LEAGUE OF NATIONS EXPERTS

THE Expert Commission on Nutrition appointed by the Health Committee of the League of Nations met on November 25 at the London School of Hygiene and Tropical Medicine. Those present were :

France : Prof. L. Alquier, director of the Institut d'Hygiene Alimentaire, Paris ; Prof. L. Lapicque, professor of physiology at the Laboratory of Physiology, Sorbonne, Paris.
Scandinavia : Dr. Axel Höjer, Generaldirektor, Medicinalstyrelsen, Vallingatan 2, Stockholm.
United Kingdom : Prof. E. P. Cathcart, professor of physiology, University of Glasgow ; Prof. E. Mellanby, secretary of the Medical Research Council, London ; Sir John Boyd Orr, director of the Imperial Bureau of Animal Nutrition, Reid Library, Rowett Institute, Aberdeen.
United States : Prof. E. V. McCollum, professor of biochemistry, Johns Hopkins University, Baltimore ; Dr. Mary Schwartz Rose, Columbia University, New York ; Dr. W. Sebrell, chief of the Department of Nutrition, National Institute of Hygiene, Washington, D.C.
U.S.S.R. : Prof. Sbarsky, director of the Central Nutrition Institute, Moscow.

Two other members of the Commission, namely, Prof. Durig of Vienna, and Prof. Schiotz of Oslo, were unable to attend the meeting.

The Commission elected Prof. Mellanby as chairman and Dr. McCollum as vice-chairman.

A statement was presented on the origin of the studies of the question made under the auspices of the League of Nations. After a general exchange of views, the Commission decided to draft a statement on scientific principles governing dietaries of certain population groups—namely, women during pregnancy and lactation, infants, school-children, and adolescents up to the age of twenty-one years.

Two sub-committees—one on energy-producing substances, under the chairmanship of Prof. Cathcart (members : Profs. Alquier, Lapicque, Sbarsky and Sebrell) ; and the other on non-energy-producing substances (such as mineral salts, vitamins, etc.), under the chairmanship of Prof. McCollum (members : Profs. Höjer and Mellanby, Sir John Boyd Orr and Dr. Schwartz Rose, with Dr. Harriette Chick of the Lister Institute as secretary)—were entrusted with the task of drawing up detailed recommendations to be submitted to the plenary commission at a later meeting.

In the course of the week, each of these committees drew up its own report, and from them a combined report covering the whole subject was drafted and, after due consideration, adopted unanimously. This report is now being printed at Geneva in English and French, and will be published in the near future. It will undoubtedly arouse great interest among those concerned, both from the scientific and social aspects of nutrition. The report of this Commission of Experts on Nutrition will then be sent on to a mixed committee which includes economists and experts in agriculture as well as representatives of the present Commission. Prof. Mellanby and Prof.

McCollum were appointed representatives on this mixed committee, with Sir John Orr and Dr. Mary Schwartz Rose as substitutes. This mixed committee will meet in February 1936 at Geneva.

The modern knowledge of nutrition being still in the stage of development, the Commission had to consider future progress. It drew up a list, in order of priority, of the problems for future study at various scientific institutes already engaged on similar lines of research, with a view to practical progress.

Educational Topics and Events

CAMBRIDGE.—The Lowndean professorship of astronomy and geometry will become vacant by the retirement of Dr. H. F. Baker on September 30, 1936. A meeting of the electors will be held on January 31, 1936. The General Board has recommended and the Council of the Senate has determined, that at this election preference shall be given to candidates whose work is connected with geometry in the widest modern sense. Candidates for the professorship are requested to communicate with the Vice-Chancellor and to send him, on or before January 14, 1936, ten copies of any statement or testimonial which they desire to submit to the electors.

It is recommended by the Faculty Board of Engineering that J. A. G. Haslam, of Corpus Christi College, be appointed assistant in research in the Sub-Department of Aeronautics with a stipend of £500 a year, made up of £300 from the University grant and £200 from Sir John Siddeley's gift for aeronautical research.

SHEFFIELD.—The title of honorary lecturer in physics has been conferred on Dr. W. H. George, Sorby research fellow.

Mr. H. T. Protheroe has been appointed assistant lecturer in metallurgy (founding).

The Rockefeller Foundation, New York, has made a grant of £200 in aid of research in the Department of Pharmacology.

THE annual report of the Yorkshire West Riding County Council on the county minor scholarships examinations, recently issued, records an important advance in the employment of intelligence tests. For the last three years, while an intelligence test has been *taken* by all candidates, it has been *used* only as a means of differentiating the border-line cases. This year it has been taken into account in all cases except those where low marks in English and arithmetic precluded the possibility of awarding a scholarship. One effect has been to give the chance of a scholarship to candidates obtaining a high 'intelligence quotient' whose marks in arithmetic and English would not last year have been high enough to bring them within the range of the border-line. The examiners believe that, as a result of the employment of the test, awards have been made only to those candidates who have the necessary ability and educational background to enable them to profit by a secondary school education. Special attention was directed last year to the widely prevalent fault of reading the questions carelessly and of introducing irrelevant matter into the answers. This fault was much less conspicuous this year.

Science News a Century Ago

The Elephant House at the Zoological Gardens

IN the issue of *The Times* of Christmas Day, 1835, is a note on the Zoological Gardens from a correspondent who says: "The elephant has taken possession of the new house which has been prepared for his reception, and he now enjoys the society of the young female of his order presented by His Majesty. The house is by far the best building in the gardens, and is every way worthy of so great a personage. There is a mode of heating it adopted which we understand is perfectly original and seems likely to supersede all other methods in use in warming churches, chapels, and all buildings having incombustible floors. The simplicity of the plan is as remarkable as it is apparently effective and unexceptional. . . . The fuel used is inconceivably small, and the cheapness, simplicity and safety of this new method of heating cannot fail to engage the attention of all scientific and practical men."

A Christmas Experiment in Magnetism

FARADAY notes in his Diary an experiment, made on the day after Christmas 1835, on "the possibility that some metals, not magnetic at common temperatures, might become so at low temperatures". He must have been occupied at the time with preparations for the Juvenile Lectures, for he gave the Christmas course of 1835–36 on electricity; but the day was a very cold one, for he records the temperature as 25° F.; and neither Christmas festivities nor lecture preparations could induce him to forgo so favourable an opportunity. The apparatus was carried up to the roof of the lecture theatre and there, where the fullest advantage of the low out-of-doors temperature could be taken, the experiment was made.

He had a magnetometer with a delicate astatic needle: "This kind of needle was used as the most delicate test". Some wires of various metals were tied up in little bundles with platinum wire. "Then cooled these bundles in liquid sulphurous acid, in watch glasses containing a little mercury also, and when below the freezing point of the mercury, brought them close to the ends of the astatic needle to ascertain if they had become sensibly magnetic; but could not observe the least indication of such an effect, though I think the temperature must occasionally have been 60° or 70° below Zero of Fahrenheit".

New Classification of Animals

ON December 26, 1835, the *Athenæum* stated: "M. de Humboldt has presented to the French Academy of Sciences, in the name of M. Ehrenberg, correspondent of the Academy in Berlin, a table dividing the animal kingdom into 29 classes. This division is founded on the organisation and generality of a type, lying in the sensitive, vascular, locomotive, nutritive, and propagative systems. Twenty-two of the groups belong to animals without vertebræ, which are divided according to the presence or absence of a heart, Cordata and Vasculosa. In the latter, the vessels do not present anything like pulsation, and the digestive organ is either simple and solitary, as in the Tubulata, or divided and multiform, as in

the Racemosa. In the course of his travels in Syria, Nubia, Dongola, the Red and Caspian Seas, etc., M. Ehrenberg has had an opportunity of examining a number of organised beings, and has continued his microscopic researches since that period; but he only offers his table as a sketch capable of perfection, and successive developments."

Christian Gottfried Ehrenberg was born in 1795 and died in 1876. His first travels, lasting from 1820 until 1826, were made with Hemprich, and it was in 1829 that he set out with Humboldt to visit the Ural and Altai mountains. His great work "Infusionsthierchen" appeared in 1838.

Goodyear and India Rubber Manufacture

QUOTING from the *New York Journal of Commerce*, the *Mechanics' Magazine* of December 26, 1835, said: "A discovery has recently been made by Mr. C. Goodyear, by which India-rubber, after having been dissolved, can be restored by a cheap process to its original whiteness, and the pure grain formed into a fabric to be used instead of cloth, leather or parchment, and can be moulded into almost any form; and can also be combined in a variety of ways with cloth, cordage or leather. Being first made white, it admits of every shade of colour, worked in, and as durable as the rubber itself. A variety of fine specimens are now being exhibited at the Mechanics' Institute at Castle Garden, which will give an idea of the general utility of the invention."

Charles Goodyear (1800–60) first turned his attention to rubber in 1834. His work of 1835 was only partially successful, but four years later he accidentally discovered the process of vulcanising. He has been called "the Palissy of the rubber industry".

Societies and Academies

LONDON

Royal Society, December 12. F. C. COURTICE and C. G. DOUGLAS: The effects of prolonged exercise on metabolism. In the normal postabsorptive subject, there is a striking fall of the respiratory quotient during rest subsequent to work which may last for hours. This is accompanied by ketosis and a progressive slow fall in the carbon dioxide combining power of the blood. Ketosis can readily be prevented by taking a carbohydrate rich diet on the previous day, but still occurred with great frequency when either an ordinary breakfast or a quantity of sugar was ingested shortly before beginning the experiment, the main effect in the latter case being apparently increased utilisation of carbohydrate during the work. The fall of respiratory quotient is attributed mainly to a reduction of the ratio of carbohydrate to fat oxidised owing to depletion of stores of available carbohydrate during the work, but in addition there may be some conversion of fat into stored glycogen, though only to a small extent. During post-exercise rest there is reduced sugar tolerance, and the possible influence of endocrine secretions on carbohydrate metabolism during muscular work is discussed. W. L. FRANCIS: The surface membranes of muscle fibres. Using Osterhout's methods as a guide, the following results have been obtained. The *p*H of fresh muscle brei is found with a quinhydrone electrode to be 7·1, in agreement with estimates by other workers of the *p*H of resting living muscle. The *p*H after 24 hours is 6·7. The composition of an aqueous solution resembling brei in its inorganic content is discussed. The stumbling block is the phosphate, which can only be made 1/5 as concentrated in aqueous solution as in the muscle fibre. The diffusion potentials between brei and various electrolyte solutions were measured. They point to the mobility of anions being very low in brei compared with their mobilities in aqueous solution. The vapour pressure of brei is found by Barger's method to be equivalent to 1·06 per cent sodium chloride. The effects of cut muscle, brei and various experimental solutions on the resting potential are investigated with the view of finding what the 'asymmetry' potential of the surface membrane would be if the media on both sides were the same. The value would be 10–20 mv. reckoned inwards. The diffusing substance need only saturate the interfibrillary spaces in order to produce its full effect on the potential at the fibre surface.

PARIS

Academy of Sciences, November 18 (*C.R.*, 201, 917–996). ABRAHAM WALD: The curvature of surfaces. P. RACHEVSKY: A dual metric geometry, based on generalised Cartan spaces. A. KHARADZÉ: A functional operator and the generalisation of Legendre polynomials. GEORGES GIRAUD: Problems of the type of Dirichlet and Neumann in certain cases where the data are discontinuous. PIERRE BOOS: The characteristic properties of certain analytical surfaces. PAUL FLAMANT: Two functions attached to a function capable of summation, and their application to the limit of Lebesque integrals. F. LEJA: A harmonic function connected with any closed ensemble of points of space. LÉON BESCHKINE: The equations of equilibrium of thin surfaces. ANTOINE MAGNAN and CLAUDE MAGNAN: Making evident small differences of the refractive index in liquid media. Application to the study of the movements of water such as that produced by the motion of a fish. The apparatus records the motion of the water on a kinematograph: six photographs are reproduced. PIERRE ERNEST MERCIER: The characteristic functions of a cantilever wing (resistance in bending). JACQUES VALENSI: Study of the flow of air round the wing of an aeroplane: marginal phenomena. Results obtained by a photographic method: two photographs are reproduced. DANIEL BARBIER: The colour temperatures of the stars. PAUL SOLEILLET: The coherence of vibrations in optical resonance. JEAN ROULLEAU: The determination of the contact resistance metal – cuprous oxide. JEAN MERCIER: Contribution to the study of the synchronisation of oscillators. CHARLES DEGARD: The diffraction of electrons by chloroform, and the structure of the molecule: the Urbain model and the tetrahedral model. The Urbain formula (the co-ordinative formula $CCl_2.HCl$) and the usual tetrahedral $CHCl_3$ both agree with the experimental results. Experiments on electronic diffraction cannot decide between the two formulæ. PIERRE JACQUET: The practically instantaneous action of certain colloids on the electrolytic deposit of copper. During the electrolysis of copper sulphate solutions, it was found that only the proteins (gelatine, serum albumin) have a marked action during the first moments of electrolysis: the gums act much more slowly. HENRI BIZETTE and TSAÏ BELLING: The magnetic double

refraction of nitric oxide. Experimental results obtained with the large electromagnet of the Academy of Sciences, the nitric oxide being under pressures of 80 and 100 atmospheres. MLLE. ARLETTE TOURNAIRE and ETIENNE VASSY: The continuous spectrum of deuterium. Comparisons of the spectra of deuterium and hydrogen show slight differences. The curves of the two gases coincide at about 4000 A., and then deviate very slightly as the wave-length diminishes. The continuous spectrum of deuterium is a little more intense than that of hydrogen. PAUL GOLDFINGER, WLADIMIR LASAREFF and BORIS ROSEN: The energy of dissociation of carbon monoxide. Among the different possibilities deduced from the CO spectrum, only the value for the dissociation energy 9·1 v.e., giving 123·6 kcal. for the heat of sublimation of carbon at 0° K., is not in contradiction with the thermo-chemical and spectroscopic data. LÉON GUILLET, JR.: The modulus of elasticity of the copper – beryllium alloys. Beryllium increases the modulus of elasticity of copper: the alloy with 15 per cent of beryllium has a modulus equal to that of steel. MARCEL PRETTRE: The influence of the gases adsorbed by the wall of the vessel on the chain reaction of mixtures of hydrogen and oxygen. JEAN AMIEL: Some organic cupritetrachlorides and cupritetrabromides. JEAN LOISELEUR: The formation of protein thioderivatives with the aid of carbon disulphide. Carbon disulphide transforms casein, gelatine and egg albumin into thio derivatives, probably by forming thiosulphocarbamic groups with certain amine groups. These substances are soluble in organic solvents. YVES VOLMAR and BJÖRGE HANSEN: The alcoholysis of olive oil. By fractional distillation under pressures below 1 mm., methyl palmitate, oleate and methyl arachidate were isolated. ALFRED SILBERSTEIN: The crystalline parameters of the double bromide of copper and ammonium. This double salt, like the corresponding chloride, is quadratic. The parameters resulting from an X-ray study are given. JACQUES BOURCART: The quaternary in the Meknès (Morocco) district. SIVASUNDEN DEB: The discovery of nummulites in the nummulitic grits of the Alpes-Maritimes, and on the origin of this series of strata. G. DENIZOT: The distribution of the lower alluvia in the Loire valley. FRANCK BOURDIER: The stratigraphy of the quaternary ante-Wurmian alluvia of the Grésivaudan and of the Chambéry valley. RAYMOND DECARY: The Mahajamba River of Madagascar and its temporary captures by the Kamoro. Details of the five changes of course of this river since 1864, conditioned by changes in the rainfall in this region. DENIS BACH and JEAN FOURNIER: The assimilation of oxalic acid by *Aspergillus niger*. ANDRÉ BOIVIN, MAX MARBE, MME. LYDIA MESROBEANU and PETRE JUSTER: The existence in *Bacillus tumefaciens* of an endotoxin capable of causing the formation of tumours in plants. JOSEPH MAGROU: The immunity and hypersensibility of the *Pelargonium* towards reinfections by *Bacterium tumefaciens*. J. ANDRÉ THOMAS: A new mode of direct cellular multiplication. Meroamitosis. PIERRE LESNE: Certain faunistic relations between Madagascar and south-eastern Africa. LÉON BINET and G. WELLER: The liver and glutathione. JACQUES PARROD: The formation of hydrocyanic acid, starting with some organic compounds, in the presence of ammoniacal copper sulphate. This appears to be a general property of reducing sugars. Carbon monoxide and formaldehyde give no hydrocyanic acid under the same conditions.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 4; 1935). P. K. RASHEVSKIJ: Metric duality in Finsler's two-dimensional geometry, particularly on an arbitrary surface. J. SEKERZH-ZENKOVICH: On the theory of currents. V. M. CHULANOVSKIJ: The rotation structure of the nitrogen molecule in the Schumann region. S. A. ARZYBYSHEV: Note on the paper "On the electrolysis of copper in rock salt" (*C.R. Acad. Sci.*, 4, 25; 1934). A. ZHUCHOVICKIJ: A new method of solution of variation problems of quantum mechanics. N. A. PREOBRAZHENSKIJ, A. M. POLIAKOVA and V. A. PREOBRAZHENSKIJ: Alkaloids of the leaves of jaborandi (6). Synthesis of racemic homopilopic acid. M. M. KATZNELSON and M. I. KABACHNIK: Amination with sodium and potassium amides. (4) Nitration of α-amino-anabasine. A. E. FERSMAN: The periodic system of energy coefficients. V. A. DEVIATNIN and V. M. DOROSHENKO: A chemical method for determining vitamin C. F. LOEWINSON-LESSING: The chemical composition of tectites. A. M. DJAKONOV: New Ophiurans from the Sea of Japan (1). S. A. CHERNOV: New data on the distribution of the Indian snake *Lycodon striatus*, Shaw, in Soviet Middle Asia.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Saturday, December 28

ROYAL INSTITUTION, at 3.—Dr. C. E. K. Mees: "Photography" (Christmas Juvenile Lectures. Succeeding lectures on December 31 and January 2, 4, 7 and 9).

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board for the Year ended 30th June 1935; with Report of the Director of Water Pollution Research. Pp. iii+51. (London: H.M. Stationery Office.) 1*s.* net. [3011

Centenary of the Birth of Andrew Carnegie. The British Trusts and their Work, with a Chapter on the American Foundations. Pp. x+155+29 plates. (Dunfermline: The Carnegie United Kingdom Trust.) [212

University of London: University College. Calendar, Session 1935–1936. Pp. xcii+578+26. (London: Taylor and Francis.) [212

Anniversary Address delivered before the Royal Society of London by the President, Sir Frederick Gowland Hopkins, November 30th, 1935. Pp. 26. (London: Royal Society.) [212

Other Countries

Union of South Africa: Fisheries and Marine Biological Survey. Report No. 12: For the Year ending December 1934. By Dr. Cecil von Bonde. Pp. 120+3 plates. (Pretoria: Government Printer.) [412

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 7: July, August, September, 1935 (Items 2728–2841.) By Ernest A. Hodgson. Pp. 141–156. (Ottawa: King's Printer.) 25 cents. [412

Tectonic Lines of the Philippine Islands. By the Rev. W. C. Repetti. Pp. 57–71+1 plate. (Manila: Bureau of Printing.) [912

U.S. Department of Agriculture. Leaflet No. 109: Eliminating Bats from Buildings. By James Silver. Pp. 5. (Washington, D.C.: Government Printing Office.) 5 cents. [912

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 66: The Influence of Growth Stage and Frequency of Cutting on the Yield and Composition of a Perennial Grass—*Phalaris tuberosa*. (Report on Co-operative Investigations at the Waite Research Institute.) By Dr. A. E. V. Richardson, H. C. Trumble and R. E. Sharper. Pp. 35. (Melbourne: Government Printer.) [912

Ingeniørvidenskabelige Skrifter. A, Nr. 41: The Plate-Jet. By Jul. Hartmann. Pp. 108+19 plates. (København: G. E. C. Gad.) 15.00 kr. [912

The Indian Central Cotton Committee: Its Objects, Activities and Achievements. Second edition. Pp. 27. (Bombay: Indian Central Cotton Committee.) [912