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History as Science

IT is given to few Commissions to earn such widespread approbation of their report as has been deservedly afforded to that of the Lytton Commission on the Manchurian dispute. Even the authoritative tributes to its fairness and impartiality from all over the world did not, however, avail to prevent a charge of bias being brought against it in the House of Commons. That such a charge could have been made is evidence of the lack of historical perspective which characterises so much of our political life to-day and so often obstructs progress towards a new international order, and above all persists in regarding as a moral issue what is now only a question of practical policy.

If this absence of historical perspective has made politicians so inept at interpreting the facts of a political situation to-day, so blind to fundamental realities, it has had no less serious consequences among the advocates of technocracy who have been eloquent of late. A grasp of the fundamental fact that the advent of power production has revolutionised the whole position of man in relation to production, and shaken his economic and social structure to its foundations, has not prevented many of its exponents from largely ignoring human values and human factors in the technical control of production and distribution which they develop. Science is only one of the factors concerned, the scientific method only one of those employed by man in his slow advance; and history affords no justification for the neglect of other methods, or for the assumption that mechanical science by itself can solve all the problems with which man is confronted. The same mistake is made to-day as was made by Bacon, who thought that the "sovereignty of man lay hid in knowledge" and that scientific discovery would ensure the fortune of the human race. Three centuries have barely yet taught us how false and dangerous is the assumption that the knowledge of how to use knowledge goes hand in hand with the growth of knowledge.

There is, in fact, something strangely similar in the attitude of those politicians who desperately strive to revert to eighteenth century ways, and ignore the immense change which has come over mankind in the last century, and in that of those who see in science a sole and sufficient guide and imagine that all man's activities can be planned on scientific lines. Each alike lacks the sense of

realities and of values which the study of history is so well able to impart, and it might be fair to place the responsibility of some at least of our difficulties on the neglect of history by our politicians and men of science alike, and on their consequent failure to interpret aright the course of present-day events.

At a time when the importance of studying the human factor is being more and more realised, when men are turning against an economic system in which increased productive powers only lead to more widespread unemployment and want, the qualities of imagination and sympathy which are essential to the understanding of history are in great demand in the affairs of society or State. The very demand and provocation of the humaner qualities which history makes, renders it an invaluable counterpart to the physical or mechanical sciences. Prof. Pollard is surely right when he urges that history is the highest form of science because its subject matter is the highest form of Nature, and that it is not commonly regarded as a science because it is too complex and too human for summary treatment by axioms, rules and formulæ.

If, however, history is not an exact science, it has much in common with the exact sciences. Dr. Tennant, for example, in the "Philosophy of the Sciences", claims first place for history in systematic order of departments of science, and asserts that it gives a far more adequate mirroring of reality than the abstract schemes of the higher sciences. Its collection of data demands qualities akin to those required of every searcher after truth whatever his field of inquiry. It is in the critical interpretation of the data acquired that history calls for qualities which are so admirably fitted to redress the balance, and in the humanisation of methods of controversy history may render its greatest service. Only by its guidance can we understand the causes of the religious, moral, political, social and economic environment in which we live. Knowledge of public action in the past provides the best means of understanding public action in the present and the surest guide for the exercise of political power. The study of history provides one way of joining to the mass of human knowledge the wisdom which alone can sort out the issues and permit beneficial action. Moreover, history, being both a science and an art, requiring a scientific analysis of materials and an artistic synthesis of results, calls for just that balance of scientific and impartial judgment, and imagination and sympathy in interpretation,

which are at the root of wise administration and constructive policy.

History, though more complex, is not in fact less capable of scientific treatment than physics or chemistry, and, apart from providing a background against which alone political issues can be understood or viewed in a true perspective, its study encourages the scientific spirit in which alone political issues can be profitably examined. It is for this more especially that General Smuts has made such eloquent pleas. Prof. Pollard again has pointed out, for example, that a course on the history of London would be the first introduction to the scientific investigation of its present-day problems of local government, the vastest problems of the kind with which the human intellect has ever been called upon to deal.

This spirit we search for in vain, for example, in the recent debate on the arms embargo. We see no signs of any policy beyond that calculated to serve the narrowest exigencies of the moment—no regard to the question of world order and international action, no facing of the problems which must be faced once at least if a community of nations is to demonstrate its determination not to allow the old methods of irrational force to be introduced, no hint of the impartial and scientific survey of the facts of the particular situation carried out by the Lytton Commission and before that by the Institute of Pacific Relations. The expediency which dominated the debate has no room for realism, for the fearless facing of facts, for the scientific inquiry and deliberate co-operation which alone stand between us and world disaster.

Leaving aside the fact that a study of the history of science itself often suggests exceedingly fruitful lines of research, it should be clear that science and history have a joint contribution to make to our national and international needs which we neglect at our peril, and which it is the duty of the scientific worker as of the scholar of history to emphasise with instant eloquence. Bacon's vision of man "that will live and be a citizen of the world" in "De Augmentis Scientiarum" holds out our only hope of survival, and it were idle for science apart from history to seek to enforce the lesson.

Granted the wide fields such as politics, human biology, sociology, economics and psychology, into which the application of scientific methods is long overdue, such methods alone will not bring us the solution we desire. Even when such fields of knowledge have been placed on a scientific

basis, there will remain the problem of human nature, and the study of human affairs by the application of physical formulæ alone is more likely to lead to mental confusion than to order. Scientific methods assist us to ascertain and assemble our facts, to clear our minds from passion and prejudice, but they can lead us to little of the rudiments of justice, ethics, logic or literature, though it must not be forgotten that the scientific attitude of mind may even yet prove to be a much more humanising element than might at first be expected when we think of it in terms of a struggle with the forces of Nature.

In the perspective and sense of values, the appraisal of human factors which the study of history engenders, we are able to assess correctly the position and responsibility of science. From this point of view we realise that the failure of the scientific worker to accept responsibility for the consequences of his discoveries inevitably means that he must accept the repression or suppression of certain aspects of scientific truth if the human race is to survive. If his citizenship is subordinated to his science, and the growth of an international civic sense does not keep pace with the advance of knowledge, society must itself take measures to prevent the perversion of science to destructive purposes. Knowledge may require insulation and control in the same way that electric power is safeguarded and its use restricted to those who can use it aright.

We come back, therefore, to the problem of relating knowledge and power in the service of the community. If acceptance of civic responsibility by the man of science is a fundamental condition before the scientific expert can play the part in human government indicated, for example, in certain phases of the work of the technical committees of the League of Nations, universal suffrage cannot be tempered with science by the efforts of the scientific worker alone. The scientific expert will only take his rightful place in national and international government as the study of history leads both administrators and the electorate to appreciate the significance of current events and tendencies.

This is a problem of education—of imparting not merely knowledge but also understanding, in ensuring that responsibility goes hand in hand with power. It is in this sphere—the teaching of philosophy by means of examples, in supplying the needed touch of human nature, that the study of history is of supreme importance in the study

of scientific politics. Imagination and insight are here as essential as in the equipment of the man of science. History, as Prof. Pollard has said, is a matter of sense as of science, of feeling as well as of fact, and it is because history is not felt that citizenship is feeble. We cannot understand why men acted unless we know how they felt; and in discovering where men failed in sympathy and understanding because they did not understand what others felt, and thus knew not what they themselves were doing, we came to the realities of history upon which good citizenship and a new world order are based. History, being both an art and a science, offers us the opportunity of harmonising the discovery and use of new knowledge in ways which permit the free expansion of the human spirit and the continuous amelioration of the lot of mankind. The scientific teaching of history, as well as the teaching of science as part of ordinary culture, are indispensable elements in that training and discipline through which alone man can acquire the self-command and the wisdom by which to regain control over events.

Chinese Medicine

History of Chinese Medicine: being a Chronicle of Medical Happenings in China from Ancient Times to the Present Period. By Dr. K. Chimin Wong and Dr. Wu Lien-Teh. Pp. xviii + 706 + 55 plates. (Tientsin: The Tientsin Press, Ltd., 1932.) G. dollars 7.50; 30s. net.

TO most people in Great Britain the whole story of Chinese medicine is contained in a legend and an anecdote. The legend is to the effect that, in China, a doctor is only paid for keeping his patients well, and never for attending and curing them when ill—a reflection, probably, on the old saying from the Chinese classics that “The sage does not treat those who are ill, but those who are well”. The anecdote is the well-known story of the sick man who went out to seek a Chinese doctor with the fewest lanterns outside his door, it being alleged that one such lantern must be hung up for every patient who had died at the doctor’s hands, and that, having at length discovered a physician with but one lantern to his discredit, he found to his chagrin that the doctor had previously attended but one patient.

These stories, apocryphal though they are, give a delightful hint as to the possible relationship between doctor and patient in the Far East, but they scarcely claim to tell the whole story of

Chinese medicine, and in the bulky and well-documented volume before us, Dr. K. C. Wong and Dr. Wu Lien-Teh (the latter, a Cambridge graduate) have endeavoured to present a connected history of medical science in China from the earliest times to the present day. To some extent the book is a misnomer, as it is far more truly a "Chronicle of Medical Happenings in China", as its sub-title suggests, than a history of Chinese medicine, nearly five-sixths of its pages being devoted to the progress of Western medicine in China since its introduction by missionaries and others at the beginning of last century. For this reason it is the earlier chapters of the book which will be read with the greatest interest, containing as they do the foundation principles upon which the system of ancient Chinese medicine was built.

In that system, accurate scientific investigation, as we understand it in the West, took little or no part, for it is a strange fact that although China has from the earliest days revered all forms of scholarship and has made noteworthy contributions in the realms of art, and literature, and political economy, she entirely missed the stream of human progress in the matter of applied science. Instead of accurate knowledge based upon experiment and research, we find strange philosophical concepts, superstitious beliefs, and magical practices mixed up with shrewd observations and records of the symptoms and progress of the more common ailments, and an extensive knowledge of herbalistic lore.

Ancient Chinese philosophy proceeded from a belief in the existence of two opposing forces, the *yang* and the *yin* (positive and negative, active and passive, hot and cold, etc.), and all functions of the body, and even the main anatomical organs, were classified under these two categories. At the same time, it was considered that there were five primary elements in Nature (metal, wood, water, fire, and earth), upon the harmonising of which peace and equilibrium depended; and disease was therefore regarded as a disturbance of this balance owing to the excessive activity of one or other of these primordial substances. The diagnosis of any complaint thus became a matter of deciding in the first place whether it was a *yang* or a *yin* disease, and, further, which of the elements was out of proportion to the remainder. Treatment was similarly directed to a restoration of this disharmony, and just as *yang* (or hot) diseases could only be cured by *yang* drugs, so also physical disturbances due to the

action of one of the five elements could only be successfully remedied by medicaments of that group.

During the Han dynasty (206 B.C. to A.D. 220) Chinese medicine made marked progress, and a number of medical treatises were then written which are quoted to this day by old Chinese doctors. These works included essays and discussions upon various diseases, elaborate studies of the pulse (regarding the character and varieties of which innumerable Chinese volumes were to appear in later dynasties), and the first attempt to produce a materia medica. The study of medicine continued to develop during the next few centuries, and though the old Chinese doctors were sadly handicapped by their ignorance of anatomy and physiology, many of them gained an accurate, if empirical, knowledge of important medical facts. The famous Pen Ts'ao Kang-Mu (the monumental Chinese treatise on pharmacology published in the sixteenth century and comprising no less than fifty-two volumes) not only refers to the usage of such well-known drugs as sulphur, mercury, and rhubarb, but also mentions remedies like kaolin, chaulmoogra oil, and ephedrine, the value of which have only recently been studied by Western pharmacologists. The treatment of such diseases as cholera, leprosy, and syphilis, and the value of inoculation against smallpox were also well understood, and an occasional genius like the renowned Hwa-To even appears to have anticipated the discovery of anæsthetics and antiseptic surgery.

Such discoveries were but fitful, and were soon buried in accretions of quackery and superstition, and as the barriers that at one time guarded the right to practise medicine gradually disappeared, the prestige of the physician rapidly fell into disrepute and the Chinese doctor became nothing but a pedlar of useless and even ridiculous concoctions.

It was the arrival of Western physicians, and in particular the very valuable work carried out through the last century by a succession of devoted medical missionaries, which restored medicine to its rightful place in China, and the greater part of the volume under review consists of a detailed account of the work accomplished by these men and women in overcoming native prejudice and establishing hospitals and even medical schools in China. With the rapid changes that have taken place during the last thirty years, the Chinese educational authorities and other agencies are now

taking the lead in this matter, whilst a noteworthy contribution has been made by the Rockefeller Foundation in the erection at Peiping of one of the best-equipped medical schools to be found in the Far East.

Biology and Philosophy

(1) *The Inequality of Man: and other Essays.* By J. B. S. Haldane. Pp. ix+295. (London: Chatto and Windus, 1932.) 7s. 6d. net.

(2) *Leben und Erkennen: Vorarbeiten zu einer biologischen Philosophie.* Von Prof. Gustav Wolff. Pp. 442. (München: Ernest Reinhardt, 1933.) 11.50 gold marks.

(1) **PROF. J. B. S. HALDANE'S** book is, as he says, a mixed bag. It consists of a number of essays, mostly short: and one piece of fiction (a thriller of correct pedigree, by John Buchan out of H. G. Wells). Some of the essays are no more than good popular journalism, some are more substantial, but all are worth reading. There is a certain unity of purpose running through them, making the book philosophical in the wide sense. This purpose is to consider the way in which scientific knowledge, or lack of it, affects human life and society. Civilisation cannot stand still but must either develop or decay. Which course it takes depends upon whether we use scientific knowledge to cut our own throats or to reorganise society. Many of the subjects dealt with by Prof. Haldane are of acute interest.

Among the more academic topics are criticisms of some of the views of Russell, Eddington and Jeans. The ordinary biologist, or any ordinary person, is afraid to dispute anything a mathematician says in case he gets snubbed for talking about mysteries beyond his comprehension. Prof. Haldane is free of such inhibitions and is therefore a valuable critic. There is just one point, however, where the reviewer would question the value of the criticism. Jeans argues that as the whole material universe is 'running down', it must have been wound up at some finite past time and must cease to run down at some finite future time. Haldane replies (pp. 165-170) that time is infinite and that the total number of different kinds of events is finite, though large, since the whole volume occupied by matter is finite and the numbers of protons, electrons and photons are finite. Therefore every possible combination of events, however improbable, must occur over and over again. It is a good debating point, but both

arguments rest on the assumption that the universe possesses a determinate time axis along which we can extrapolate as far as we like. They assume that the four dimensional figure is like a cylinder with time parallel to its axis; whereas an expanding universe must be more like a cone. The apex, if it is an apex, is in the past, but there is nothing to show how to extrapolate our time axis beyond the brief period about which we have positive information.

(2) Prof. Haldane's book provides easy reading for a few hours, Prof. G. Wolff's heavy reading for many hours (and no index). Perhaps it is only insular prejudice, but the reviewer doubts if those many hours will be as well spent as those few. Prof. Wolff propounds and develops a 'vitalistic' philosophy. The issue between 'vitalism' and 'mechanism' is by now scarcely a live one. A man cannot be a one hundred per cent mechanist because he has to exclude his own mind from the mechanistic scheme; nor can he be a one hundred per cent vitalist unless he is a solipsist because he must allow some validity to the mechanistic scheme. The controversy really turns upon the minor question of where to draw the line, or else of whether there would be a line to draw unless the problem was misstated. Fortunately Prof. Wolff leaves no doubt as to where he draws the line, for he states his position at the very beginning. He considers that the living and the lifeless differ absolutely, and the difference is that living organisms are purposive or teleological while lifeless things are not (p. 19). The author does not appear to put forward any evidence for maintaining this radical division. Indeed the evidence all points the other way. The differences between a stone and a dog are obvious enough, but in the series, bacterium, filterable virus, bacteriophage, enzyme, inorganic catalyst, the difference between living and lifeless is hard to define. Moreover we must believe, if we believe anything, that at some time in the earth's history life developed out of something that was not living (cf. Haldane's essay "The Origin of Life").

Finally, if there is such a science as physiology, which many have doubted, a considerable part of that science consists in investigating by the methods of physics how it is that organisms and their parts carry out purposive processes. The physiology of the eye is an account of how it fulfils the function of sight, of how a certain pattern of structures and processes produces normal or efficient sight and how certain devia-

tions from the pattern render the eye less effective for its purpose. The question of purpose is there throughout, but the methods are the orthodox methods of physics. It is true that the physiologist, like the engineer, makes use of terms and concepts that have no place in the classical theory of physics, as laid down by Descartes and Newton; but it is permissible to conclude that the classical theory can be revised and expanded, and not necessarily that physiology is no part of physical science.

Of course, if the natural world was split by a radical dualism such as Prof. Wolff assumes, then science would be impotent in its own domain and the philosopher might well disregard its efforts and construct a purely idealistic philosophy on subjective lines. This, in effect, seems to be what he does. In any event, the case for a purely idealistic method in philosophy is an arguable one, though the arguments do not convince everybody; but it is very doubtful whether the case is improved by pretending that what are really subjective concepts have been derived from biology.

A. D. R.

Early County Maps of England

Reproductions of Early Engraved Maps. 2: English County Maps in the Collection of the Royal Geographical Society. With Introduction and Notes by Edward Heawood. Pp. ii+14+Atlas of 21 Sheets. (London: Royal Geographical Society, 1932.)

THIS group of twenty-one reproductions, in black and white, of maps of England will be of great value to all interested in the history of cartography. The original maps were all printed from engraved copper plates; some of them were originally over-painted by hand in colours, but these admirable reproductions are necessarily made from unpainted copies. The twenty-one plates comprise one general map of England and Ireland, by an unknown author, dated 1594; nineteen county maps strictly so called; and one sheet of playing-cards, illustrated by miniature county maps. The county maps proper vary in date from Saxton's "Southamptonia" of 1575 to John Speed's version of Norden's map of Sussex, dated 1610; so that it may be said that the Royal Geographical Society has reproduced a selected group of the earlier county maps, and has not, in the present publication, reproduced any of the later and more detailed maps on larger scales, such as Roque's Surrey or Taylor's Hampshire.

An excellent feature of the present publication

is that we are able to compare the work of different cartographers. Here we are given Saxton's Hampshire, which can be compared with Norden's map of the same county, on the same scale, of about twenty years later. Norden's map is more detailed but is not so pleasant or easy to read. We have also in this collection two versions of Surrey, Cheshire and Hertfordshire, and three of Sussex. One might construct a mathematical mean of some of these maps which would presumably be more reliable than any one of them.

The county maps reproduced include five by Christopher Saxton, the father of modern English mapping; three by John Norden, whose work is original and independent. Then we have Philip Symonson's map of Eastern Kent, published in 1596; and a series of seven maps, out of a known total of twelve, belonging to "a homogeneous series", of unknown authorship, dating from the early years of the seventeenth century, based generally on Saxton or Norden, with variations; then two maps prepared for Camden; two published by John Speed, copied in the case of Sussex from Norden, and in the case of Cheshire from Saxton, with some alterations. It is a rich cartographical feast.

The collection is accompanied by an introduction and detailed notes by Mr. Edward Heawood. There is much to be learnt from the remarks of this high authority, and many curious facts are brought out, with reference, for example, to the manuscript maps of William Smith, "Rouge Dragon"; or to the work of Symonson of Rochester; or to Norden's maps of nine counties, which were original productions and not copies from Saxton. Mr. Heawood tells us that the "anonymous" series, is, as regards the engraving, of the Dutch-Flemish school; and, as regards the material, is influenced by both Norden and Smith. He also remarks that although John Speed did not always acknowledge his almost complete indebtedness to Saxton or Norden, "in any case Speed did good work in assembling material otherwise scattered", and points out that Norden himself valued Speed's editorial work.

A small correction is required on p. 9, where Saxton's "Southamptonia" is described as not dated; actually the date 1575 will be found under the coat of arms in the south-east corner.

Geographers owe a debt to the Royal Geographical Society for having thus rendered accessible facsimile copies of these important early county maps, some of which are of great rarity and some unique.

Short Reviews

Modern Methods in Quantitative Chemical Analysis.

By Dr. A. D. Mitchell and Dr. A. M. Ward.
Pp. xi+178. (London, New York and Toronto :
Longmans, Green and Co., Ltd., 1932.) 6s.

In this book the authors have, as they clearly explain in their preface, deliberately selected from the large number of new methods available in analytical chemistry, in order to provide, in a conveniently limited space, details of one really sound analytical procedure for each of the substances discussed. They state the principles on which they have made their selections: that methods involving the use of the sintered glass crucible are preferable to those necessarily confined to "Gooch": that the methods should be as little empirical as possible: that they should have a definite bearing on analytical practice: and that they should not involve the use of inaccessible reagents.

After a description of "Some Methods of Wide Application"—methods involving the formation of positive halogen ions, the use of adsorption indicators and oxidation-reduction indicators, oxidation with ceric sulphate, the uses of organic complexes, and the use of the Clemmensen Jones 'reductor'—there follow detailed methods for the quantitative estimation of sixty-seven different elements, radicals and compounds. The book has also a table of atomic weights, dilution tables and a full index.

The excellence of the book's general production, as well as the lucidity of all its expository matter and the catholicity of the authors' analytical 'taste', combine to make this a book quite literally indispensable to all engaged in the practice of analytical chemistry. It is much to be hoped that its circulation will warrant the frequent production of new editions and supplements. A. L. B.

Die geologische Erforschung Thüringens in älterer Zeit: ein Beitrag zur Geschichte der Geologie bis zum Jahre 1843. Von Prof. Dr. B. von Freyberg.
Pp. xi+160+8 Tafeln. (Berlin: Gebrüder Borntraeger, 1932.) 7.50 gold marks.

THE variety in the geological formations of Thüringia, and the abundance of minerals and fossils in that part of Germany, led early to the study of its natural features. So long ago as 1710, Buttner published his "Rudera Diluvii testes", which was based on observations in Thüringia; and in 1756 J. G. Lehmann gave a good description of the stratified rocks around Mansfeld, thus producing a pioneer work in stratigraphical geology. In 1761 G. C. Füchsel published a remarkable account of the geology of the country, with new ideas well in advance of the time; while between 1755 and 1773 J. Walch issued the first important large treatise on fossils. In 1820 Baron von Schlotheim's "Petrefaktenkunde" made much advance in the modern study of fossils; and in 1822 K. E. A. von Hoff began the publication of

his classic work on the explanation of geological phenomena by the study of changes now taking place on the earth's surface, which was a precursor of Lyell's "Principles of Geology".

In the new volume now before us, Prof. B. von Freyberg gives an excellent account of these and other achievements of geologists in Thüringia up to the year 1843. It includes a table showing the successive advances in knowledge of the stratigraphy of the country, and is illustrated by several beautiful portraits, of which that of von Hoff will particularly interest English readers.

The History of the Phlogiston Theory. By Dr. J. H. White. Pp. 192. (London: Edward Arnold and Co., 1932.) 6s. net.

THIS little book, originally a thesis for the Ph.D. degree of the University of London, is written, according to the author, to dispel the mists which are gathering around our conception of the phlogiston theory: indeed, definite misstatements with regard to it are becoming increasingly common. In any event, it is useful to have in one book the full story of the wax and wane of the theory through a century of chemical history. At the outset of the eighteenth century, alchemy was flourishing and the philosopher's stone was still eagerly sought. By the end of it, quantitative chemistry had begun, chemical combination was being understood: chemistry had advanced in spite of the phlogiston theory, the work of Lavoisier had overthrown the doctrine of Stahl.

Dr. White divides his book into a dozen chapters and gives a number of references; he has been to the original material in the British Museum Library. He ends, as is proper, with some definite conclusions, of which perhaps one of the most significant is that the phlogiston theory did little to stimulate research. This must always be the prime object of any theory; even if a hypothesis is proved to be wrong, it will not have been made in vain so long as it has been productive of experimental work. We regard the essay as a useful and a fruitful one, which will repay perusal by serious students and others interested in the past of chemical science.

Die gruppentheoretische Methode in der Quantenmechanik. Von Prof. Dr. B. L. van der Waerden. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 36.) Pp. viii+157. (Berlin: Julius Springer, 1932.) 9.90 gold marks.

THE difficulties of group theory are no doubt considerable, but here is a book of reasonable size which gives a fairly elementary account of the application of the theory to quantum mechanical problems. It is now well known that Schrödinger's

wave equation leads to the discrete energy levels for the hydrogen atom required by Bohr's theory of 1913, but here it is shown how group theory, when applied to angular momentum in connexion with the wave equation, leads to important conclusions as to the energy levels of more complicated systems. Quantum numbers appear in an almost magical manner.

The book may be warmly recommended to the theoretical physicist, but the experimenter may wonder whether the principles of symmetry which are involved in the group treatment could not be developed and applied with less elaborate mathematical apparatus. One is left with the feeling that considerable simplification may yet be effected in the presentation of these results, so that even a non-mathematical reader may be able to grasp the main issues. But, in the meantime, this small volume is likely to be of service to those seriously attacking the subject.

Vision and Colour Vision. By Dr. R. A. Houstoun. Pp. vii + 238. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 15s. net.

DURING the past twenty years, Dr. Houstoun has carried out many researches at Glasgow on the subject of vision and colour vision, and it is indeed fortunate, in these days when so much attention is given to the advertising value of a research subject, that so able a physicist is willing to work in a subject of such poor advertising value. Many physicists are too absorbed in the complexities of the atom to pay attention to the physics of vision and it would be of interest to know how many psychologists and physiologists are able to tackle the mathematics involved.

On reading this volume, which includes not only Dr. Houstoun's but also all other important work on the subject, one can well see that the author's devotion is due to the fascination of the phenomena. Studies of vision, like those of hearing, are much complicated by the power of adaptation of the organ of perception. The same result is not obtained when a red and a blue lamp are matched on a photometer bench close up to the photometer and afterwards at a great distance from it. Intensity discrimination, dark adaptation, acuity of vision, colour, flicker and fatigue phenomena all receive full treatment. After demonstrating the inadequacy of the Young-Helmholtz theory of colour vision, the author's own theory is proposed.

Evolutionist and Missionary, John Thomas Gulick: Portrayed through Documents and Discussions. By Addison Gulick. Pp. xvi + 556 + 3 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1932.) 22s. net.

THE Rev. J. T. Gulick, who died in 1923, was an American missionary who will be remembered for his researches on the land-shells of the Sandwich Islands. He made a large collection, and observed that there were numerous species and varieties of

each genus, which were restricted not merely to the same island, but even to the same valley. He thus elaborated a theory of divergent evolution by isolation, which he discussed in papers to the Linnean Society of London and in four letters to NATURE. On this subject he corresponded with A. R. Wallace, and especially with G. J. Romanes, who gave Gulick's work a prominent place in the third volume of his "Darwin, and after Darwin" (1897).

An interesting biography of Mr. Gulick, based on his letters and papers, has now been published by his son. One chapter is devoted to his correspondence with Romanes, and another gives a general summary of his scientific work, illustrated by three beautiful plates of the land-snails of the Hawaiian Islands.

Intermediate Physics. By Dr. C. J. Smith. Pp. viii + 650. (London: Edward Arnold and Co., 1932.) 14s. net.

FROM the point of view of science teaching, a physics textbook of intermediate standard is of great importance because for so many students it represents the end of their acquaintance with physics, the basic experimental science. The present volume is carefully written and is well illustrated with clear diagrams and references to the applied sciences. In view of the general teaching of calculus in schools, the author has not hesitated to use the notation and occasionally the methods of the calculus. At the end of each chapter is a good selection of numerical and other examples to be worked by the student.

The author has not ventured into the controversial and difficult problem of combining a little instruction in scientific method with the instruction in physics, and the book forms a good straightforward and conventional treatment perhaps specially suitable for the student likely to continue his physics beyond the intermediate stage.

The Medical Value of Psychoanalysis. By Dr. Franz Alexander. Pp. 247. (London: George Allen and Unwin, Ltd., 1932.) 10s. 6d. net.

DR. FRANZ ALEXANDER has dedicated his book on the "Medical Value of Psychoanalysis" to his master, Sigmund Freud, and it must be admitted that the pupil has proved worthy of the master.

It is very often a thankless and difficult task to convince medical readers of the value of psychoanalytical theories and practices. The author has, however, made out a very strong case for the development and improvement of medical education by the addition of courses in medical psychology, two courses being provided for undergraduates and one for graduates.

So many behaviour problems as well as what are obviously neurotic reactions are made to appear simple by the application of psychoanalytical technique to their investigation that the great value of psychoanalysis to medicine can no longer be denied.

Milne's Theory of the Expansion of the Universe

By DR. G. C. McVITTIE

PROF. E. A. MILNE has recently put forward in these columns¹ and also elsewhere² a theory designed to account for the phenomenon of the recession of the spiral nebulae on purely kinematic grounds. The basic idea of this theory is both simple and elegant and can be described as follows.

Consider a swarm of particles moving with constant, but otherwise arbitrary, velocities in an infinite Euclidean space. The swarm has spherical symmetry around a point at which we can suppose an observer *A* to be stationed who employs a rectangular set of axes (*x, y, z*) and a Newtonian time *t* to describe the motions of the particles. Suppose that at *t* = 0 the swarm occupies the interior of a sphere *S* around *A*, who is at *x* = 0, *y* = 0, *z* = 0, the space outside *S* being empty. Then as time goes on, the particles will necessarily move out of *S*. For example, those near the surface of *S* having velocities directed away from *A* will immediately move out of *S* whilst others may have to traverse a portion, or the whole, of the sphere before they get outside it. But it is obvious that, given a sufficient lapse of time, the particles will sort themselves out so that eventually only the slowest moving ones will remain inside *S*. All the particles will, moreover, be now receding from *A*. If the original distribution of the velocities was continuous and included the velocity zero, there will always be some particles left near to *A*, and in fact it is not difficult to see that the average velocity of the particles at a distance *r* from *A* at time *t* is *r/t*, so that there is an approximate correlation of velocity with distance. Thus the behaviour of the swarm will be very similar to that of the spiral nebulae observed in Nature, practically all of which are moving away from us with velocities which increase linearly with the distance.

The above result still holds when the distribution of particles is supposed to be infinite, provided only that there is an initial concentration of particles in the neighbourhood of *A*.

Milne now asks the question: What must be the space and velocity distribution of such a swarm so that a second observer, *A'*, moving relatively to *A* with constant velocity and using a Euclidean space-frame (*x', y', z'*) and a Newtonian time *t'*, should have an equivalent view of the swarm? The principle of special relativity will ensure that the views of *A* and *A'* are consistent: to make them identical, Milne puts forward an extended principle of relativity, namely, "not only the laws of nature, but also the events occurring in nature must appear the same to all observers, wherever they be, provided their space-frames and time-scales are similarly oriented with respect to the events which are the subject of observation". These two principles are sufficient to enable him to determine, purely as a problem in statistics, the

space and velocity distribution function of the swarm. It is, in terms of *A*'s co-ordinates,

$$\psi \left(\frac{Z^2}{XY} \right) \frac{dx dy dz du dv dw}{c^6 Y^{5/2} X^{3/2}} \tag{1}$$

where

$$X = t^2 - (x^2 + y^2 + z^2)/c^2, \quad Y = 1 - (u^2 + v^2 + w^2)/c^2, \\ Z = t - (ux + vy + wz)/c^2.$$

This is the number of particles counted by an observer who sees the swarm centred around himself, in the volume-element *x* to *x + dx*, *y* to *y + dy*, *z* to *z + dz*, having velocities lying between *u* and *u + du*, *v* and *v + dv*, *w* and *w + dw*. All observers, of course, are supposed to be at the origin of their space-frames. The second observer *A'* will have an identical picture of the swarm if, and only if, his co-ordinate system is related to that of *A* by a Lorentz transformation of type

$$t' = \beta(t - Vx/c^2), \quad x' = \beta(x - Vt), \quad y' = y, \quad z' = z; \\ \beta = (1 - V^2/c^2)^{-1/2}. \tag{2}$$

A' then sees the swarm centred around himself, and both *A* and *A'* count the same number of particles for equal volume-elements and equal velocity-intervals in their respective co-ordinate systems. Observers of this kind we call of 'class *A*'.

The condition that *x* = 0, *y* = 0, *z* = 0, *t* = 0 for *A* corresponds to *x'* = 0, *y'* = 0, *z'* = 0, *t'* = 0 for *A'* is necessary for the invariance of (1) under the transformation (2) and hence is necessary for the equivalence of the two pictures of the swarm. Consider now a third observer *B* who is defined as being at rest with respect to (say) *A*. He uses a co-ordinate system of type

$$t'' = t, \quad x'' = x + a, \quad y'' = y, \quad z'' = z, \tag{3}$$

where *a* is a constant giving the distance from *A* to *B* as measured by either of them. Milne recognises that *B* will not have an equivalent view of the swarm and attempts to overcome this difficulty by identifying *B* with an observer *A''* of class *A* who is moving past *B* with velocity *a/t* at the instant *t*, having been at *A* at time *t* = 0. But it is not easy to see how this can be justified either on mathematical or on physical grounds. It would thus appear that Milne's extended principle of relativity is equivalent to a definition of a certain class of observers, namely, those who have equivalent views of the swarm of particles. These observers all coincided with one another and with the centre of the swarm 'simultaneously' and all set their clocks to read *t* = 0 when this happened. This moment can also be supposed to correspond to the moment of greatest concentration of the swarm and is so taken by Milne.

The distribution function

$$\frac{(\text{constant}) dx dy dz du dv dw}{Y [c^2 \sum (x - ut)^2 - \sum \{v(z - ut) - w(y - vt)\}^2]^{3/2}} \tag{4}$$

has been specially studied by Milne: it arises

from a particular solution* of his equation for ψ and corresponds to the case of rectilinear motions of the particles of the swarm as viewed by an observer of class A . This is therefore the case when the interactions of the particles are neglected. It follows that at $t = 0$ there were an infinite number of particles at the origin. At any subsequent $t > 0$, particles which were initially at the origin and moving with velocity V , will have got to $r = Vt$ and evidently these particles again have an infinity in their distribution at that distance. Thus these infinities recede from the observer with velocities proportional to their distances from him. The general effect of gravitation is to remove these infinities and to replace them by density-maxima in the distribution of the particles. Thus finally we have a set of groups of the original particles which appear to any observer of class A to recede from him according to the law $r = Vt$. However, there still remain singularities in the distribution of the groups on the sphere $r = ct$, so that the latter are strongly concentrated there. Milne identifies the groups with the spiral nebulae, thus obtaining the law of velocity of recession proportional to distance. The concentration towards $r = ct$ is shown to be consistent with the apparent uniform distribution of the nebulae owing to the rapid diminution of

brightness due to the high velocity an object acquires on approaching this bounding sphere.

From the observed correlation of 500 km. per sec. for every 3.25 million light years distance of a nebula and the law $r = Vt$, it follows that $t = 2 \times 10^9$ years have elapsed since the system of the nebulae was at its greatest concentration.

We may in conclusion contrast Milne's theory with that based on general relativity. The latter deals only with the group of observers at rest with respect to one another, who are observing a set of particles also at rest with respect to the observers in the sense that the total momentum of the particles is assumed to be zero. The particles initially are in a state of unstable equilibrium and the expansion is due to what may be called a 'cosmical repulsion'. In Milne's theory the particles are initially in motion and are not in an equilibrium state. The observers considered are not at rest with respect to each other. The expansion is simply due to the fact that the particles in a certain region have higher velocities on the whole than those elsewhere. Both theories are in accordance with observation and it seems impossible to decide definitely for or against either so long as the phenomenon of the recession of the nebulae, in isolation from all other phenomena, is to be the only criterion.

* NATURE, 130, 9-10, July 2, and 507-508, Oct. 1, 1932.

² Z. Astrophysik, 6, 1-96, Jan., 1933. See also E. Freundlich, Naturwiss., 21, 54-59, Jan. 27, 1933.

* It appears as the *only* solution in the paper quoted in (2). Prof. Milne has since discovered others.

Nitrogen-Uptake of Plants

PROGRESS, due to the abandonment of traditional beliefs, is occurring to-day in agriculture as well as in other branches of applied science. At one time it was generally held that ammoniacal nitrogen had first to be converted into nitric nitrogen before it could be taken up by plants, but we now know of many plants that take up ammoniacal nitrogen directly; and at the present time doubt is being cast on a doctrine which has persisted since the days of Liebig and Boussingault, namely, that organic nitrogen has first to be 'mineralised' before it becomes available as food for plants. The work done by Prof. A. I. Virtanen and his collaborators at Helsingfors during the past few years has provided important evidence that at least some plants directly and readily assimilate organic nitrogenous compounds, and a useful summary of this work was given recently by Prof. Virtanen in lectures delivered to the Netherlands Agricultural Society at Wageningen and to the Chemical Society of Zurich.

Earlier experiments showed that certain legumes, for example, red clover, did not grow so well when the nitrogenous food derived from the root nodules was replaced entirely by ammonium nitrate, but that peas utilised both forms of nitrogen equally well, whilst white clover responded better to ammonium nitrate than to the food provided by the nodule bacteria. These and other observations led to the hypothesis that legumes

take up their nitrogen from the nodules in the form of organic compounds, and that these compounds constitute the best form of nitrogen-nutrition for certain legumes. It was also found that these compounds diffuse into the surrounding soil, from which they are taken up by growing plants, like *Gramineae*. Both pot and field experiments have shown that, when the pH of the soil does not fall below 6, one pea plant can provide sufficient nitrogen for two oat plants, but if the ratio of oats to peas is greater than two to one, both plants suffer from lack of nourishment.

Investigations were then made using sterilised sand and pea seeds inoculated with nodule bacteria, and it was found that the nitrogenous matter that diffused into the sand consisted entirely of organic compounds, which were almost equal in amount to the nitrogen compounds directly taken up from the nodules. It was also established that nitrogen compounds diffuse into the soil from young and fresh root nodules of the alder tree, thereby enabling the latter to assist the growth of other trees.

Analysis of the substances that diffused into sterile quartz sand from the roots of pea plants that had been strongly inoculated showed the chief constituent to be amino-acids: in percentages of total nitrogen, amino-nitrogen 77.4, ammonia-nitrogen 0, amido-nitrogen 3.30, nitrogen in volatile bases 2.73, humin-nitrogen 2.05.

The question then arose whether non-legumes could take up and utilise these nitrogen compounds directly, and to solve it pea and barley plants were grown together in sterile sand contained in three-necked Wouff bottles, the pea seeds being inoculated, and each kind of plant being made to grow out through a neck of the bottle. The nutrient solution used contained no nitrogen. The barley plants grew excellently, but in the control experiment, in which the pea seed was not inoculated, they failed to grow. It was also found that barley, as well as peas, grew exceedingly well right up to the flowering or fruiting stage when they were fed with an aqueous extract of a low moorland soil that contained no ammonia or nitric nitrogen; they also grew well when they were fed in sterile culture with peptone (Witte) as their sole source of nitrogen. It is therefore concluded that higher plants can take up and utilise directly organic nitrogen compounds present in soils before their nitrogen is mineralised by bacteria or other micro-organisms.

The nature of the organic nitrogenous compounds that are of value to plants, as well as their percentage utilisation, is now being investigated. Earlier experiments in which red and white clovers were grown under sterile conditions inside glass

flasks showed that red clover responded well to hydrolysed casein and to aspartic acid, and less well to ammonium salts and nitrate, whereas with white clover the results were exactly opposite. In these experiments the hydrogen ion concentration of the nutrient solutions containing hydrolysed casein and aspartic acid remained constant, showing that the nutritional effects were due to the amino-acids themselves and not to ammonia that might be liberated by their decomposition. The later experiments, in which the plants were grown with their roots in sterilised nutrient solution or sand and their upper parts in the air, have shown that aspartic acid is a very good nutrient for legumes, but not for *Gramineae*, and that asparagin is excellent for barley, but much less good for *Leguminosae*.

The manner in which the plants utilise such organic compounds can at present only be conjectured. On one hand, it may be that enzymes like urease, asparaginase or aspartase liberate ammonia from these organic compounds when they are still in the root system, and that the plants utilise this ammonia to synthesise protein. On the other hand, it is also possible that the amino-acids may be utilised directly for the synthesis of protein.

Enzymes: A Discovery and its Consequences

By DR. E. F. ARMSTRONG, F.R.S.

IT is a hundred years since Payen and Persoz discovered diastase and recognised it as a ferment. To-day the ferments, or enzymes as we have preferred to call them, are in the forefront of interest as the factors concerned in all those chemical changes in the cell which in their totality are termed vital changes: they may indeed compose those invisible genes which make up the chromosomes. The discovery of diastase, apart from its broader consequences, has had a far-reaching effect also in introducing science into one of the oldest industries, one already established on the Nile in the days of the Egyptians, that of brewing: the determination of diastatic power is to-day one of the first exercises which is performed on the new season's crop of barley and malt. The studies on diastase made in the cause of brewing have in turn enriched chemical science, and there is a notable list of eminent brewers' chemists to inscribe on the roll of honour of enzyme pioneers.

The discovery of Payen and Persoz in 1833 followed an observation by Kirchhoff that germinating barley grains contained a principle capable of converting starch into sugar, a power which Leuchs discovered was also possessed by human saliva. Payen and Persoz found out how to extract ground germinating barley with water and, after filtration, precipitate a white flocculent material by means of alcohol, which when dried and re-dissolved turned starch into sugar. Their procedure was that which is followed to-day in extracting an enzyme, though our hands have gained not a

little cunning in concentrating the enzyme and freeing it from this and that impurity, largely as the result of methods devised and elaborated by Richard Willstätter, who was Davy medallist of the Royal Society in 1932. The active material was named 'diastase' by its discoverers. It was found by them to be present in other cereals during germination, and during the 'seventies, numerous workers established that diastase is very generally present in vegetable cells so long as the latter are living. In the meantime, Miahle had made a diastase by adding alcohol to saliva, and other observers found it in the animal pancreas. Animal diastase is generally referred to as ptyalin in the literature and in many textbooks the term amylase is preferred to diastase; a proper sense of historical loyalty should, however, make us adhere to the older term.

In any mention of the diastase story, the work of Horace Brown and Morris in connexion with the translocation of starch comes immediately to mind. The formation of diastase in foliage leaves during darkness and its conspicuous diminution during bright sunshine, were discovered by them and used to explain the behaviour of starch, which varies in amount in the opposite sense during the twenty-four hours. Classical also are the studies of Cornelius O'Sullivan at Burton-on-Trent of the action of malt diastase on starch, published in 1876: they mark a beginning of the efforts to establish the kinetics of enzyme reactions and also to unravel the structure of starch itself.

We are still working at this problem—starch—nearly sixty years later, without any certainty that the goal is in sight, though the work of Haworth is definitely carrying us forward: it is successful perhaps because he is taking nothing for granted and is insisting on the need of relying only on the evidence furnished by quantitative laboratory work. The newer branches of chemistry, X-ray analysis and colloid conceptions, have been called in to help establish the size and form of the starch molecule, but the results obtained with their aid are definitely of a more speculative character.

Many have toiled, others may be said to have toyed, with the kinetics of enzyme action, but the chief result has been to introduce confusion into what at bottom is simple, once the disturbing factors have been eliminated. We would rather write of diastase in relation to starch from the point of view that the enzyme itself must be a composite material. The evidence is becoming more precise that the maltose units in starch are not all joined together in the same manner and that there are perhaps two different and separable diastases, which act differently upon starch, one producing the α -form of maltose, the other the β -form.

Starch is the largest item in our dietary, it is the most common reserve material of plants, in the industrial arts it has a thousand and one uses, it is the basis of beer, its study forms the most intriguing chapter of vital chemistry. Is it not remarkable that there is still more that is obscure than is definite in our knowledge of the structure of its molecule and its microscopic and macroscopic make-up?

Following the discovery of diastase, other enzymes attacking substances other than starch have been found in both plants and animals. Studying the behaviour of first one and then another of these, it has become possible to establish their general properties, in particular their high degree of specificity, the ease with which their activity is destroyed or modified by chemical or physical alteration. They have very many properties of the living unit, except the all-essential one—they are incapable of self-duplication. The enzyme particles are non-resolvable under the microscope. Jerome Alexander has emphasised their resemblance to the self-reproducing ultra-microscopic genes of which the chromosomes are thought to contain immense numbers, and there are adherents for the idea that the genes may be regarded as enzyme-like catalysts, capable of self-duplication, which dominate by their catalytic control of chemical changes what is to happen in their neighbourhood. They are capable both of self-duplication and of initiating and controlling each and every chemical reaction in the cell, the only proviso being that the necessary raw materials for the catalysed reactions are provided in the milieu and that the supply of the raw materials and the removal of the products of metabolism proceed at suitable rates of speed. Each gene may

be supposed to catalyse one reaction only and its catalyst to be composed of a single molecule; in practice, there will always be large groups or strings of genes. Our methods of isolating and purifying or concentrating enzymes, after the breakdown and killing of the cell, aim at the selection of the catalyst derived from a single gene: it will be obvious how Utopian this quest must be.

The great majority of enzymes act, like diastase, as catalysts of hydrolysis; that is to say, the elements of water enter into the reaction, which indeed commonly takes place in the presence of an excess of water. The amount of water in the cell, its relative abundance in a free and active state, unattached to or uncombined with other substances, is an extremely important, if not the determining, factor in governing the direction and position of the final equilibrium, for it is in the highest degree probable that the same catalyst which favours hydrolysis can also, under other conditions, accelerate the reverse change, that of synthesis. The factors which control the activity of a cell are the catalyst, a supply of raw materials and the presence of more or less active water. When there is excess of water the reactions are those of hydrolysis; when there is a scarcity of water and the cell sap is concentrated or saturated, which is another way of expressing that the water molecules are all occupied, the reactions are those of synthesis.

There is now a consensus of opinion that enzymes consist largely of organic matter made up of at least two units, the carrier, forming a large colloid particle, and the other, the active substance, which is held or oriented in an efficient position and stabilised by the carrier. Without the carrier the catalyst cannot function, and consequently, when the process of purification leads to a disruption of the carrier, the catalyst loses its activity. Such a statement is to some extent incompatible with the possibility of isolating a definite crystalline enzyme, as Northrup claims to have done for pepsin and trypsin; more enlightenment is obviously required on this point before a final opinion can be pronounced.

The enzyme study began with Payen and Persoz; its first century of endeavour may be said to have ended with the anniversary address of Sir Frederick Gowland Hopkins to the Royal Society last November, wherein he summarises the present conception of an enzyme and emphasises the importance of the conviction which is now general amongst biologists that modern chemical methods, starting with isolated reactions made with tissue extracts and passing to studies of other tissue extracts in which the progress of a variety of reactions is studied, do in fact give a picture of the reactions which are taking place in intact or still living tissues or cells. In his words, we have escaped from the dilemma voiced in earlier dogma, that since chemical methods convert the living into the dead, they can do nothing to elucidate the dynamic events of life.

Such is the progress of the century. Since the discovery of the first enzyme we have travelled far to form a conception of an enzyme as an active spot of specific configuration at part of the surface of the colloid particle. Progress has been slow, largely because chemists and biologists have not been ready for such a conception and all that

its application involves. Now at the beginning of the second century of enzyme study, things are different; the authoritative summary by the president of the Royal Society in closing the old period serves to open the new at a moment when the army of research workers is ready to apply it.

Obituary

PROF. C. CORRENS

THE death on February 15 of Prof. Carl Correns at the age of sixty-eight years leaves a gap in the ranks of those who were prominent in the Mendelian investigations from their inception in 1900. Much of his work was in the more obscure and difficult fields of plant genetics, such as self-sterility, variegation and the inheritance of sex. He brought a wide knowledge of plants and a broad biological outlook to bear on these and other problems, and will always be held in remembrance as one of the three co-discoverers of Mendel's principle of segregation in hybrids.

When Hugo de Vries published his paper "Sur la loi de disjunction des hybrides" in the *Comptes rendus* of the Paris Academy of Sciences in March 1900, announcing the re-discovery of Mendelism, based on the study of eleven different species, Correns was stimulated to write immediately, as he says, a paper for the *Berichte der deutschen botanischen Gesellschaft*, which was entitled "G. Mendel's Regel über das Verhalten der Nachkommenschaft der Rassenbastarde", in which he showed how he had independently arrived at the same conclusions as de Vries through experiments with maize and peas. He, like de Vries, at first thought his results and conclusions were new, and then found Mendel's paper of 1866 with similar results and the same explanation of them, namely, the principle of genetic segregation. In the previous year he had published an explanation of the phenomena of xenia in maize and in 1901 he wrote another extensive and classical paper on this subject.

Correns was thus a leading spirit in the re-discovery of Mendel's laws and in a clear statement of the mode of sex determinations in dioecious and polygamous flowering plants. Important investigations on the latter subject were published in 1907, in which the Mendelian conceptions were applied to the inheritance and determination of sex in plants. This was the period when active discoveries of the sex chromosomes in insects were taking place, and in 1913 he published in collaboration with Goldschmidt a general work on what we would now call the genetics of sex. Several other investigations of sex in plants appeared during the next decade, *Melandrium*, *Silene* and *Rumex* being among the forms mainly studied.

Many of Correns's researches were fundamental and he preferred to labour in fields that were off the beaten track. The number of plant genera

with which he worked at different periods was a surprisingly large one. In a series of papers on *Mirabilis* hybrids, beginning in 1902, he showed that when the yellow and white varieties are crossed, the F_1 is rose-coloured with red stripes while the F_2 produces no less than eleven colour types. This was important at a time when it seemed that Mendel's law of dominance might be as fundamental as his law of segregation. The influence on the offspring of the number of pollen grains placed on the stigma was also investigated in *Mirabilis*, and several interspecific hybrids of *Matthiola incana*, *M. glabra* and other species were analysed. Other genera the genetics of which he studied included *Urtica*, *Trinia*, *Hyoscyamus*, *Dimorphotheca*, *Lamium*, *Veronica* (long and short style), *Linum* and *Fagopyrum*.

Correns was interested in the rôle of the cytoplasm in inheritance and published an important paper on this subject in 1909. He studied variegation and its inheritance, finding cases where the development of the chloroplasts was under nuclear control and therefore Mendelian in inheritance, while in other cases the control was cytoplasmic. His paper at the Berlin Congress of Genetics in 1927, of which he was a vice-president, was a masterly summary of knowledge regarding non-Mendelian inheritance in plants and animals, but he was prevented by illness from giving it in person.

So early as 1889, Correns made a study of pollen germination and the pollen tubes of *Primula acaulis*, and much later he showed in *Melandrium*, by placing a few pollen grains on the stigma, that the upper ovules of the flower are generally fertilised first.

Darwin's experiments on self-sterility led him to the view that in such cases each plant, although self-sterile, can be fertilised by pollen from any other plant. This hypothesis of individual stuffs was held until the work of Correns on *Cardamine pratensis* in 1912, in which he found that the offspring of two crossed plants fell into four infertile groups, and the inheritance of self-sterility could be explained on a Mendelian basis. This conception has since been confirmed and extended in other genera. In 1928, however, Correns found that in *Tolmiea Menziesii* the individuals from a cross were fully fertile with each other, as Darwin had supposed, and it is possible that in this species the determination of the stuffs inhibiting pollen tube growth is not genotypic but phenotypic.

Correns was born in Munich on September 19, 1864, his father being a painter and a member of the Bavarian Academy of Art. In 1892 he went to Tübingen and in 1899 was made an extraordinary professor in that University. He went from there to Leipzig in 1902, and in 1909 became professor of botany at Münster in Westphalia. It was there that I first met him, in 1910. An animated discussion with him in the streets of Münster, surrounded by curious onlookers, made one feel rather like one of the disputants in a university town in the Middle Ages. With his bright red hair, thick glasses and large hands with extremely long nails trimmed to a point, he was a man of extraordinary appearance in his younger days. When the Kaiser Wilhelm Institute for Biological Research was founded at Berlin in 1914 he was called to be its first director and was also made an honorary professor in the University of Berlin. His connexion with this research institute was maintained to the end, its extensive garden, greenhouses and laboratories being the scene of all his later work. An early work, published in 1899, had to do with vegetative multiplication in the mosses, but nearly all his later investigations had some bearing on genetics.

In 1924, on the occasion of his sixtieth birthday,

Correns's collected works on plant genetics, numbering sixty papers, were published in a volume of some 1,300 pages. He married a niece of Nägeli and published (1905) Mendel's letters to Nägeli, in which an unsuccessful attempt was made by Mendel to interest Nägeli in his views regarding the phenomena of heredity. They were republished as an appendix to the volume of collected works.

Correns may be said to occupy a somewhat similar place in modern plant genetics to that of Kölreuter in the eighteenth century. His results were always clearly and methodically presented. He held several honorary degrees, was a member of the Prussian Academy of Sciences, and in 1931 was elected a foreign member of the Linnean Society of London.

R. RUGGLES GATES.

WE regret to announce the following deaths :

Prof. C. W. Cook, professor of economic geology in the University of Michigan, known for his work on oil geology, on February 17, aged fifty years.

Prof. Erik G. Odelstierna, professor of the metallurgy of iron in the Technical High School, Stockholm, from 1904 until 1918, aged seventy-nine years.

News and Views

Education and Economic Recovery

IN his chancellor's address to the University of New Zealand, Dr. J. Macmillan Brown emphasised the contribution of education to recovery from the periodic economic and financial depressions in the assistance it gives to the growing mind to understand the methods and efforts of the past. Youth must be trained to know the data of the situation before it is stirred to investigate and learn the full terms of the problem before attempting its solution. Accordingly, education, and especially advanced education, should be the last element in a civilised community to be submitted to the axe of economy in meeting the want and suffering associated with a depression, and the pruning of educational resources in New Zealand and elsewhere is a definite setback to recovery. The two essentials in the recovery of a community from depression are the broadening and deepening of the intelligence of the mass so as to enable them to learn the lesson of thrift and foresight, and highly developed leaders capable of seeing far into the darkness of the future and leading their fellows to the highest practical goal. The selection and training of the intellectual leaders is the more important for advance in research, and a large proportion of exceptional material is left undeveloped in the absence of scholarships to select and carry it through its course.

It is the true function of a university, Dr. Macmillan Brown said, to select the research workers and leaders of thought who will save mankind from

these recurrent dilemmas. Universities and institutions which prepare for them are the main means by which the methods of one generation are stored up and improved for the benefit of subsequent generations. Dr. Macmillan Brown pointed out that more and more widely is it being realised that self-isolation of the individual, the caste, the community, and the nation is suicidal and destructive of progress, and he urged that the transmission of advance from one community and one generation to others can only be effective, beyond such institutions as the British Commonwealth of Nations and the League of Nations, if there is fellowship and effective international co-operation between the universities. With the universities and their graduates forming the constituencies in every nation and community, mankind might make some approach to a world parliament or at least to a conference which would be competent to indicate sanely the conditions that should belong to a federation of the world. Dr. Macmillan Brown concluded his plea for the place of a trained intelligence in the direction of the affairs of mankind by pointing out that university education must be built on broader foundations than narrow specialisation and be capable of selecting the wisest, most developed minds and characters the community can produce.

Roman Richborough

AFTER eleven years excavation on the site of Roman Richborough, it is at last possible, according to the account of the most recent discovered given by

Dr. J. P. Bushe-Fox before the Society of Antiquaries on April 6, to assign a purpose to the large timbered buildings occupied during the first half century of the Roman conquest of Britain. It is now evident that these buildings, differing in character from both barracks and structures for domestic occupation, were port store-houses for grain and other material. The outlines of rotted beams, piles and foundation trenches, indicate that they were erected in rectangular blocks or *insulee*, each comprising four buildings. Of these, one faced the main road and the other three lay behind, with approaches from the side roads which bounded the *insulee*. Each building was provided with a loading platform, while that facing the road had also a space in front in which carts might draw up. This building was erected on a massive beam platform, embedded in the soil, to take heavy weights; but the remaining three were erected on piles to give the ventilation necessary to protect corn against the effects of damp. No other granaries such as these are known. Another building, also unique in character, lies on the other side of the road. It is a rectangular structure erected around a court. Each side consists of two rows of rooms, ranged in pairs. It is conjectured that these were the quarters of the police guarding the stores. Dr. Bushe-Fox describes the whole base camp as an unprecedented discovery. His account of the arrangements for unloading and storing material had an almost disconcertingly modern note.

Completion of the Grid in Great Britain

THE fifth annual report of the Central Electricity Board, which has just been published, is of special interest as it is the last of the reports marking the construction of the grid in Great Britain. It has only taken six years to complete instead of the estimated eight years. The cost is less than 27 million pounds and is within 2½ per cent of the original estimate of the Electricity Commissioners, a very satisfactory result considering the work has been so accelerated. In future, the main business of the Central Board will be in connexion with grid trading. The main function of the grid is to see that there is an abundant supply of electrical energy at each central station so that the engineers will have more time to devote to the increase of their sales. The report shows that continuous expansion is taking place in outlying areas supplied by secondary transmission lines. The Weir Committee thought that it would be best that most of the secondary transmission should be carried out by the distributing authorities, but the Central Board found it best to regard these lines as part of the grid and so help the distributors. Successful researches have been made on methods of cheapening the cost of tapping the grid. This is a step towards supplying sparsely populated districts with electric light and power and thus encourages rural development. Instead of a tapping costing £20,000, it is hoped to reduce it to £4,000. It was feared at one time that difficulty would be obtained in getting wayleaves, but out of twenty-one thousand wayleaves obtained, less

than six hundred (2·83 per cent) had to be acquired compulsorily.

The French Grid

THE new electric transmission line which has just been opened between the Massif Central and Paris will greatly facilitate the supply of electrical energy in France. The station on the River Truyère, a tributary of the Garonne, is one of the largest and finest hydro-electric stations in Europe. We learn from the *Electrician* of March 24 that the pressure is 220 kilovolts; this compares with 132 k.v., the pressure used on the British grid. The line starts from Rueynes, passes by Marèges, Eguzon and Chagny and ends at Chevilly, which is south of Paris. At present, the line can carry 100,000 kw. When the new Sarrians station is completed in a few months' time, the power transmitted will be doubled by means of a second line which is under construction. The first part of the 220 k.v. line was constructed by the Paris-Orleans Railway in order to safeguard its supply for traction purposes. It was first operated at 150 k.v., but this was modified a year ago by the addition of supplementary insulators to the strings of insulators then in use. This enables it to work at 220 k.v. Luckily, the three overhead conductors had been placed 7·8 metres apart initially, so the conversion was easily effected. The average span between the lattice towers is 250 metres and the lines are of steel-cored aluminium. The distributing stations for the Paris region are supplied by three underground lines with energy at 60,000 volts. Provision has been made so that five more of these lines can be laid when required. The important falls of the Massif Central are now connected with Paris. The joining up of the stations at the falls in the Alps and on the Rhine with the falls of the Massif Central is a most satisfactory engineering achievement.

Sir Ambrose Fleming on Television

THE fourth Exhibition of Television and Photo-Electric Apparatus was opened at the Imperial College of Science, London, S.W.7, by Sir Ambrose Fleming on April 5. In the course of his remarks, Sir Ambrose said that the invention of television has gone through the usual three stages. First, when everyone thought it could not be done at all. Second, when leading experts declared that even if it could be done, it was no possible use, and third, when the wiseacres said, we knew it could be done, but it is not a commercial proposition. "It has been my good fortune to be closely and practically connected with the introduction into great Britain of three important inventions, namely, the telephone, the incandescent electric lamp and wireless telegraphy, and I have seen these three stages illustrated in them all. Television by Baird's system is now a practical achievement and capable of being of real entertainment value, as those know who have seen the nightly demonstrations of it by a good receiver. Our great grievance at present is the impossible hour at which the B.B.C. broadcast it, namely, 11-11.30 p.m." There is need for a careful scientific study of the

subjects that can be 'televised'. Television is a new art and has new principles connected with it. The substantial facts on which it is based are well known and the keen amateur is doing not a little to push it forward. This exhibition showed how much has been done in this respect, and also how much is being done by great corporations with large resources.

It is, however, necessary that the ideas of the public on television should not be turned in the wrong direction by exaggerated or imaginary statements as to its real and possible achievements, because then only disappointment results when the true facts are known. "We cannot yet televise directly a cricket match at Lords or a Cup football contest at the Crystal Palace. But what we can do is to take on a moving film with a camera certain not very quickly moving objects of large size and televise this film. There is an immense field in this respect for educational work. The Latin poet Horace told us, what every advertiser knows well, namely, that memory of the eye is more tenacious than memory through the ear. We can televise geometrical diagrams, lessons in botany, physics, and zoology, and countless other useful visions. Let us hope that this new weapon science has provided will not be vulgarised or put to base uses, but employed for the instruction, elevation and national entertainment of the public at large."

Eugenics and Marriage Laws

IN a note contributed to the *Bulletin of Hygiene* for February, Lettin M. Crump discusses the introduction of pre-marital health certificates from the point of view of eugenics. In Mexico, impediments to marriage include insanity, and similar restrictions extending to imbecility or feeble-mindedness are found in certain of the United States. The growing practice of requiring a certificate from a qualified medical practitioner for insurance purposes, as well as from candidates for public appointments, seems likely to undermine opposition on this score, and with a more enlightened public opinion the need for compulsion would be greatly lessened. In some countries, notably Austria, Germany and some of the United States, the establishment of centres for giving advice on all matters concerning marriage has found favour. Useful advice can only be given when the investigator has a knowledge of the applicant's physical and mental condition as well as of his hereditary background and that of his proposed partner, the type of inheritance of any heritable disease or defect which may be present in the pedigree and of the effect which other causes may have upon the appearance of such heritable conditions. Mendelism provides us with a growing body of available information concerning inheritance in man, and evidence collected in the working of marriage advice bureaux leads to the conclusion that feeble-mindedness is in many cases inherited and usually behaves as a recessive; the mating of possible heterozygotes is undoubtedly to be discouraged. Although evidence collected from pedigrees is frequently both vague and faulty, justice demands that every available means of making public such

information as exists should be fully used so as to enable the conscientious citizen to avoid handing on defects from generation to generation.

Anthropological Teaching and Research in Australia

THE passing of a resolution by the Australian and New Zealand Association for the Advancement of Science at its meeting at Sydney in August last, urging upon the Government the need for anthropological training for all white people who hold positions of authority or control over natives, has moved Prof. Raymond Firth to open the new volume of *Oceania* (vol. 3, pt. 1) with a survey of the progress of anthropology in Australia in the period 1926-32. The choice of this period as the limit of his survey is determined by the fact that its beginning coincides with the setting up of a Department of Anthropology in the University of Sydney and the appointment of Prof. A. Radcliffe-Brown to the chair, as the result of a resolution passed at the Australian meeting of the Pan-Pacific Congress in 1923. At the same time, a comprehensive scheme of research was initiated under the direction of the Committee for Anthropological Research of the Australian National Research Council, for which funds have been generously provided by the Rockefeller Foundation. In what has been accomplished, much has been due to Prof. Radcliffe-Brown, who, in virtue of his position in the University of Sydney and on the Research Council, has acted as a link in bringing closely together teaching and research. Investigation has been directed to both human biology and social anthropology. Not only has the work of Spencer and Gillen in central and northern Australia been continued and extended, but Prof. Radcliffe-Brown and others have also conducted investigations in areas in the east and the west of the continent. In looking forward, Prof. Firth sees that much virgin soil has to be explored, not only in Australia, but also in New Guinea and Melanesia; but in the first-named, he points out, there is need for haste lest the material vanish.

Racial Distributions in Palaeolithic Europe

IN some 'notes' contributed to the *Proceedings of the Prehistoric Society of East Anglia* (vol. 7, pt. 1) Mr. M. C. Burkitt offers some interesting suggestions as to the possibly dual origin of the races and cultures of palaeolithic age in Europe. He points out that it is no longer possible to accept the unflinching regularity of the sequence of cultures as originally classified by the French archaeologists, and points to the contemporary existence, as proved by the fossil fauna, of a core industry, the *coup de poing* of Chelleo-Acheulean times, on the west bank of the Rhine and of flake industries on the east bank, the two intermingling on the border line in eastern France, in southern Belgium and in Britain as seen in the Levallois and Clactonian industries. He goes on to point out that, while the *coup de poing* does not occur east of the Rhine with a few exceptions, the flake industry can be traced, except for certain gaps, from east of the Rhine right across Europe and Asia

to China, where perhaps it finds its prototype in the flake implements of Peking man. This, to his mind, suggests a dual origin for the races of early palaeolithic Europe, one branch coming from Africa where the *coup de poing* occurs with some frequency, and the second bringing the flake industry from Asia. He applies the same argument to Aurignacian man, pointing out that while the female statuette of upper palaeolithic date has never been found in Africa, it occurs in Russia and examples have recently been found so far east as Maltá in Siberia. As the African affinities of Aurignacian man, or rather of his culture are not to be questioned, Europe would again in this period represent the point of confluence of two streams of migration.

Prof. A. Stoll's Researches in Biochemistry

THE biochemists in Germany publish their results in the *Biochemische Zeitschrift*, and some ten thousand original papers have been published in it in the past twenty-six years. The American and British work has been even more fruitful, at least in quality, during this period, so that there is little wonder that we are beginning to make progress in unravelling both the nature and structure of the substances found in the living cell and in understanding something of the reactions which take place there. Prof. Arthur Stoll of Basel has recently put together, for the purpose of a lecture, his own experiences since 1909 in developing some sections of biochemistry ("Ein Gang durch biochemische Forschungsarbeiten", pp. 41+5 plates. Berlin: Julius Springer, 1933. 3 gold marks), much as in another walk of life a traveller might do on his return from a lengthy journey. Stoll began research with Willstätter and the chlorophyll molecule, and he returns to it at the end of his journey, for it has not yet given up all its secrets. In the meantime he has concerned himself with ergot, with scillarín, and with the digitalis glycosides. His pamphlet, which is illustrated, makes attractive reading: we concern ourselves too much nowadays with the abstruse intricacies of our sciences, and would be well advised to view them occasionally from a wider angle.

Reopening Limestone Oil Wells with Acid

THE natural flow of an oil well may recede either from the exhaustion of the oil supply or as the result of a stoppage of the pores of the oil-bearing rock cutting off the free supply of oil. In the past, somewhat drastic methods have been tried to overcome this drawback, but they are difficult to carry out, especially at a depth which may be half a mile below the surface. When the well is in a limestone formation, it has now been discovered that it is possible to open it up again by treatment with successive quantities of 10 or 15 per cent hydrochloric acid, which dissolve new channels in the calcareous rock and permit of a new flow of oil. The use of hydrochloric acid is only made possible by the addition to it of 1-5 per cent of an arsenic compound, which inhibits the action of the acid on the metallic casing and pump tubes of the well. Other inhibitors,

including certain organic nitrogen bases, have been discovered but the arsenic compounds are the most convenient to apply in practice. The discovery has been made by the Dow Chemical Co. in partnership with the Pure Oil Co., and patented as the Dowell process: it is described in greater detail in the News Edition of *Industrial and Engineering Chemistry* for February 20. The use of acid made inactive towards metal surfaces is a novel and important one: it may be a revolutionary factor in oil production. Further, it is likely to be beneficial in natural gas production and in other directions. It is certainly an achievement to be able to control the action of a strong acid as a boring agent half a mile below the surface.

Petroleum Production in Russia

ACCORDING to Science Service of Washington, D.C., the petroleum production of Soviet Russia has now attained the position of being the second largest in the world, the estimated yield last year being 150 million barrels. Many factors have conduced to this remarkable advance, but chiefly the confiscation of oil property and its operation under Government directorship without competition have been responsible. The fields have the additional advantage that they are well situated for transport of oil to foreign markets and they are also easy to develop and operate. Another factor in the situation is the results of exploratory work, which have indicated the existence of potential oilfields along a tract of country stretching from the Arctic Ocean to the Caspian Sea. From the point of view of economics, as emphasised by Mr. R. C. Beckstrom to the American Institute of Mining and Metallurgical Engineers recently, Russia's home consumption is based mainly on industrial development and particularly on the extensive use of tractors for agricultural purposes, while external markets for oil lie chiefly with Italy, France and England, to which more than forty million barrels were exported last year. If the ambitious goal of more than 480 million barrels of oil production for 1937 is realised by the Soviet authorities, then clearly the whole scheme of international stability, in so far as petroleum supplies are concerned, will receive a severe shock.

Institution of Heating and Ventilating Engineers

THE Institution of Heating and Ventilating Engineers of 12, Russell Square, W.C.1, now issues a *Journal*, the first number of which was published in March. The object of the *Journal* is to keep its members in touch with the latest practice both at home and abroad and in particular to give them the latest results of the research work being done on the subject. In the first issue, an important paper by E. Herring is published giving the methods that have been employed for warming and ventilating the Masonic Peace Memorial building in Great Queen Street, London, W.C.2. As many masonic meetings will be held there, it was necessary to use special precautions so as to eliminate the possibility of sound being transmitted from one room to another. All the fans, motors, and machinery had to run silently and it was necessary that the rate of ventilation and

the temperature of each room should be controlled from the engineer's room, so as to obviate the necessity of the engineering staff having to enter any 'lodge' room. The 'lodge' rooms are designed to give a maximum supply of conditioned fresh air equivalent to 1,750 cub. ft. a head an hour. A refrigerating plant is installed for cooling and removing the moisture from the air when necessary. In winter, hot water is supplied by steam-heated storage calorifiers but in summer, owing to the small demand, an electrical thermal storage system is employed. Steam for all purposes is generated by four steam boilers working at a pressure of 100 lb. per sq. in. and capable of evaporating 7,000 lb. of water an hour at 212° F. Storage for the oil fuel is provided by five cylinders having an aggregate capacity of sixty tons.

Research at the Dove Marine Laboratory, Cullercoats

THE Report of the Dove Marine Laboratory, Cullercoats, Northumberland, for the year ending June 30, 1932, has recently been published. The research during the year dealt chiefly with herring investigations, work on pollution, conditioned responses in fishes and hydrographical records. Large numbers of young herrings with three winter rings were present in the East Anglian October shoals. A new year class, that of 1928, has appeared in the winter shoals about the north of Scotland. It was not present in the samples from north-west Ireland. Mr. Storrow's work includes notes on organisms coming with the Atlantic waters during the last few years, the abnormal flow in all probability influencing the herring fishery, especially in the Clyde. His conclusions from the age composition of the Northumberland herring shoals are that the data support the idea of a gradual change in the fishing rather than change due to recent oceanic activity. Prof. Meek's work, with the help of Miss Benton, on *Sagitta*, shows that *Sagitta setosa* may be an important indicator of currents. Dr. Bull's researches on fish behaviour have been helped greatly by the erection of a partially sound-insulated and entirely separate building. Conditioning experiments involving the stimulus of small temperature increments and changes of direction of current flow are in progress and positive results have been obtained. In his work on the study of colour vision by the technique of differential inhibition, Dr. Bull has shown that the common shanny, *Blennius pholis*, has a wide range in wave-length discrimination, being able to distinguish one colour from another in many instances.

Coco-nut Palm Products

COCO-NUT oil derived from copra is by far the most important ultimate product of the coco-nut palm, and the future prospects of the industry are reviewed in a volume under this title, which appears as the second volume of a "Survey of Oil Seeds and Vegetable Oils" (London: H.M. Stationery Office, 2s. net). Within the last ten years there has been an increase of about thirty per cent in the world acreage under coco-nuts, bringing the total to 7,000,000 acres in 1931. Since 1921 the British Empire has accounted

for slightly more than half this amount. The increase in production has been mainly due to the demand from the United States, but the needs of that country can be met by the production from the Philippines. Other producing countries, including those of the British Empire, must be chiefly dependent upon European consumption. Owing to the heavy production of whale oil, however, there is at present no sign of an increased demand in the European market. In this market the demand for coco-nut oil depends upon the expansion of the soap and margarine industries. The survey concludes that the output of copra will be on the increase for several years and that the bulk of this will appear on the world market, although local consumption accounts for a considerable proportion of the output of most producing countries, especially of India, the Dutch East Indies, and the South Sea Islands.

Science Museum Handbook of Pumping Machinery

THE recently issued handbook to the collection of pumping machinery at the Science Museum (H.M. Stationery Office, 2s. 6d. net) prepared by Mr. G. F. Westcott, should be of widespread interest. It is not a catalogue to the exhibits but a general introduction to the development of pumps illustrated by drawings and photographs of actual plant or models. The ground it covers extends from the earliest baling appliances to the most recent molecular vacuum pumps. After a general review of what may be called the philosophy of pumping, there are four sections dealing in turn with pumps for liquids, pumps for gases, high vacuum pumps and multiple purpose pumps. There are thirty plates in all, including a reproduction of the Museum chart illustrating the development of pumping machinery. This ingeniously worked-out chart might prove useful in many technical schools. One illustration of great historical interest is that of the famous pumping plant erected at Marly by order of Louis XIV for supplying water from the Seine to the fountains at Versailles. With its fourteen water-wheels, its 253 pumps and its connecting mechanism, it was probably the largest machine ever erected. Its effective horse power, however, was very small and it is said that the King of Denmark once remarked to Louis that his water cost him as much as his wine.

Death Valley a new 'National Monument'

ON February 11, by presidential proclamation, President Hoover gave the status of 'national monument' to Death Valley, famous in the history of California for the hardships endured by pioneer trains crossing its arid, salt-crusted waste (Science Service, Washington, D.C.). A national monument differs from a national park only in respect to grade of protection; administration is simpler, either because of difficulty of access, lack of funds to provide full national park administration, or other reasons. The area of the new monument is 1,601,800 acres, about two-thirds of the total land in the Valley, and its dryness is so great that mineral salts of several varieties form thick crusts upon the surface of the soil. Of these, the borax deposits used to be

worked commercially. In spite of its dryness, Death Valley is by no means barren; more than 500 kinds of plants live there and on these subsist many animal species. Some of the notable natural features are Telescope Peak, Furnace Creek, a green valley despite its name, and Ubehebe Crater.

Engineering Research in Japan

THE National Research Council of Japan (Imperial Academy House, Ueno Park, Tokyo) publishes a series of journals or reports each of which deals with some branch of science. Of these, vol. 8 of the *Japanese Journal of Engineering* has recently reached us. This consists of a book of 90 pages containing abstracts of 313 papers read before various scientific and technical societies or contributed to periodicals in 1928. The abstracts are grouped under civil engineering, mechanical engineering, naval architecture, aeronautics, electrical engineering, mine engineering and metallurgy. Though the papers themselves are written in Japanese, the abstracts are in English and for the greater part have been written by the authors of the papers. In general, the subjects dealt with follow the lines of engineering research in other countries, and the volume shows that Japanese engineers have a keen appreciation of the value of original investigation.

Awards of the Royal Geographical Society

HIS MAJESTY THE KING has approved the award of the Royal medals of the Royal Geographical Society as follows: Founder's medal, to Mr. J. M. Wordie, for the work he has done in polar exploration from the voyage of the *Endurance* in the Weddell Sea in 1914-17 to the present day; Patron's medal, to Prof. Erich von Drygalski, for his researches in glaciology both in the arctic and the antarctic regions. The Council has awarded the Murchison grant to Dr. Noel Humphreys, for his expeditions in Ruwenzori; the Back grant to Miss Freya Stark, for her journeys in Luristan; the Cuthbert Peek grant to Dr. L. S. B. Leakey, for his studies on climatic changes in East Africa; and the Gill memorial to Khan Sahib Afraz Gul Khan, of the Survey of India, for his frontier and trans-frontier explorations and surveys.

Announcements

MR. M. T. DAWE, director of agriculture, Cyprus, has been appointed by the Secretary of State for the Colonies to be director of agriculture and forests, Palestine.

THE Gesellschaft Deutscher Naturforscher und Aerzte will not meet this year. The next meeting, the ninety-third, is to be in Hannover in 1934. Local secretaries are: Prof. C. Müller and Prof. Dr. Willige, both of the Technische Hochschule, Hanover.

At the meeting of the London Mathematical Society on April 27 at 5 p.m. at Burlington House, Prof. B. L. van der Waerden, of the University of Leipzig, will deliver a lecture on "Hypercomplex Numbers". Members of other scientific societies who may be interested are invited to attend.

ARRANGEMENTS are being completed for the holding of the 1933 meeting of the Canadian Phytopathological Society at Regina, Sask., in July, in conjunction with the World's Grain Fair and the C.S.T.A. Convention. A committee under the chairmanship of Dr. P. M. Simmonds, Saskatoon, has been appointed to look after local arrangements. The secretary of the Association is T. G. Major, Central Experimental Farm, Ottawa.

THE papers read at the conference on "Protein Swelling and Allied Phenomena" held at the Leather-sellers Hall, E.C.2, on December 1, are being reprinted in book form, including the introductory address by Prof. F. G. Donnan. The book is of about 124 pages, and copies will be shortly obtainable from the Offices of the International Society of Leather Trades Chemists at 17, Market Street, London, S.E.1; price 5s. 6d., including postage.

THE Quekett Microscopical Club has arranged a series of demonstrations in connexion with microscopy, which are being given on the same evenings as the ordinary fortnightly meetings for the next three months. The meetings are held in the rooms of the Medical Society of London, 11, Chandos Street, Cavendish Square, W.1. Tickets for the meetings can be obtained from Mr. Milton Offord, 8, Culmington Road, West Ealing, W.13. A brochure containing lists of recent additions to the library, cabinets and collections of instruments, of the Club has recently been published, price 1s. Further information regarding the Club can be obtained from the secretary, Mr. W. S. Warton, 35, Doneraile Street, S.W.6.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An organising mistress for domestic subjects in the North Riding of Yorkshire—The Secretary, Education Offices, County Hall, Northallerton (April 25). A chief engineer and manager of the Government Electrical Undertakings, Ceylon—The Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (April 28). A principal of the City of Leeds Training College—The Director of Education, Education Department, Leeds (April 29). A demonstrator in the Department of Zoology at the Bedford College for Women, Regent's Park, N.W.1 (April 29). A Grade 1 engineering assistant at the Mines Department—The Under-Secretary for Mines, Establishment Branch, Mines Department, Cromwell House, Dean Stanley Street, S.W.1 (May 1). A probationary assistant naval constructor of the Royal Corps of Naval Constructors—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (May 1). A headmaster of the Nautical School and School of Fishermen, Boulevard—The Director of Education, Education Offices, Guildhall, Hull (May 6). A professor of education at the University of Leeds—The Registrar. A junior full-time teacher in the Department of Engineering of the Municipal Technical College, Oldham—The Director of Education, Education Offices, Oldham. An assistant instructor in the School of Navigation at University College, Southampton—The Registrar.

Letters to the Editor

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

Phenomenal Regression to the Real Object

DR. THOULESS'S interesting article in NATURE of February 25 on this subject is of special interest at the present time when physicists, physiologists, and psychologists are co-operating in the solution of problems regarding vision. The terminology and modes of expression are not unusually quite different in the respective branches of investigation, and this makes it very imperative that there should be full mutual discussion regarding the statements involved so as to avoid the possibility of misunderstanding.

The following remarks may err through misunderstanding on my part of Dr. Thouless's exact meaning. But it seems to me that his statement that Fechner's law (expressed in the form $E = k \log(R/R_0)$) implies that there is a single sensation intensity for every stimulus strength may be misinterpreted as to its implications. Clearly, for example, if R_0 is constant while R is a stimulus of variable magnitude but constant quality, the statement holds. But it has to be remembered that the three variables in terms of which, as a minimum, R is usually expressed, may also appear in R_0 ; and that R_0 is usually dependent also on many other variables. Examples of these are the time which has elapsed since the stimulus began, or the times which have elapsed since preceding stimuli began or ended, or the qualities of these stimuli, or the physiological condition of the observer as dependent on precedent exercise, bodily or mental, and so on. It is evident that, unless these extraneous variables are kept constant, one and the same sensation will not in general result from a definite external stimulus.

Recognition of these conditions has direct application to the interesting cases discussed by Dr. Thouless in which the presence or absence of an additional datum, such as the distance of an object, has influence on the result of the given stimuli. But it is then a matter for experiment to determine the form of the function of that additional datum which, being introduced into the threshold value R_0 , will include the more general results within the scope of Fechner's law for single-valued sensation.

This raises the question of whether or not subjective, as well as objective, data should be treated similarly in so far as that may be found possible. The influences of memory, expectation, bias of any type, and so on, have to be eliminated or allowed for as new qualitative or quantitative data. Further, since external action produces mental activity, may not independent mental activity give rise to alteration of these mental activities? Physical analogies suggest this as a possibility. The scope for investigation on these lines is immense, but its results may not of necessity lie outside the field expressed by Fechner's law.

The interesting results which are indicated in Dr. Thouless's diagram seem to be perhaps in part due to the actual conditions of projection. If the inclined circle be viewed from a sufficiently near point, a marked excess of the apparent short diameter over

its normal projection actually exists; and the curve is not an ellipse. But no rough method of measurement gives an accurate test, while an indirect guessed measurement is very liable to error.

W. PEDDIE.

Department of Physics,
University College,
Dundee.
March 2.

I AGREE with Prof. Peddie that the Fechner relationship need not necessarily involve a single sensation strength for every stimulus strength, but that implication is strongly suggested by the habitual statement, as the fundamental law of sensation strength, of a law which expresses this strength as a function of one variable (stimulus strength) and not of three or more. The attitude of mind induced by Fechner's law has certainly been the relative neglect of the effects of spatial and temporal contrast (treating these as mere disturbing factors) and the complete neglect of the effect of the total situation under complex conditions of perception. This seems to be sufficient justification for making Fechner's law the starting point of a description of a quantitative investigation of the effects of the total situation.

I certainly agree that any such variable may affect the absolute threshold in such a way that E remains the same function of R/R_0 . I know of no investigation to prove that this is the case. I do not think that the question is important, since the formula $E = k \log(R/R_0)$ is indefensible even for uniform contrast conditions, since it assumes the validity of Weber's law for stimulus values down to the threshold value, which is found experimentally not to be even approximately correct.

Prof. Peddie's last paragraph is based on a misapprehension. If an inclined circle is observed from a near point the short axis of the projected figure will certainly be relatively longer than it would be if the observation were made from an infinite distance when the projected axis-ratio would be equal to $\sin \theta$ (if θ is the angle of inclination of the disc to the line of vision). The error resulting from this miscalculation of the projected axis-ratio would have been small but I did not make this mistake. Nor did I use a rough method of measurement. The only rough measurement I mentioned in my article was for the demonstration of the presence of the effect (not the exact measurement of it) by means of an elongated ellipse. Since the effect is large, it is easily perceptible to rough demonstration. Where, however, quantitative results were required, the measurements and calculations were as accurate as I could make them.

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Photosensitised Decomposition of Ozone by Chlorine

THE decomposition of ozone, photosensitised by chlorine, has been the subject of numerous investigations, and it would appear from recent work that the kinetics of this reaction are by no means so simple as at first supposed. In particular, the recent paper of Heidt, Kistiakowsky and Forbes¹ describes a complex dark reaction which occurs simultaneously with the photosensitised decomposition. We have read this paper with great interest, since we have

also been engaged in an investigation of this reaction, and whilst our results confirm those contained in this paper, we are unable to agree with the authors' interpretation of them.

We have found that, with pressures of ozone and chlorine above 100 mm. (and light of $365m\mu$) a red liquid oxide of chlorine separates on the walls of the vessel. The ratio $Cl_2 : O_2$ determined by the method of Schumacher and Stieger² agrees closely with the formula $(ClO_2)_n$.

The oxide is presumably to be identified with the mist noted by Allmand and Spinks³ and by Heidt, Kistiakowsky and Forbes¹; the former authors note

$10^\circ C.$ for the decomposition of the oxide; this is of the same order as that noted by Heidt, Kistiakowsky and Forbes for their "dark reaction". Our apparatus is essentially similar to that used by them, and on account of the separation of the oxide we have not attempted to measure quantum efficiencies at chlorine pressures above 100 mm., since it is impossible to do so by pressure increase. Our results at lower pressures of ozone and chlorine indicate, on the other hand, that reproducible results are obtained when separation of the oxide is not allowed to occur, and that, while inert gases have no effect on the course of the reaction, oxygen had a distinct inhibiting effect. These results will shortly be published elsewhere.

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G. H. J. NEVILLE.

Department of Physical Chemistry,
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Feb. 21.

- ¹ *J. Amer. Chem. Soc.*, **55**, 223; 1933.
² *Z. Anorg. Chem.*, **184**, 272; 1929.
³ *J. Chem. Soc.*, 599; 1932.
⁴ *J. Chem. Soc.*, **123**, 2328; 1923.
⁵ *Z. Anorg. Chem.*, **147**, 233; 1925.

Electrometer Triode in the X-ray Ionisation Spectrometer

MR. J. A. C. TEEGAN, writing in *NATURE* of February 25, mentions that the application of the electrometer triode to X-ray ionisation spectrometers is under consideration. I have successfully used this valve for this purpose during the past three years and saw it in use in Germany even earlier.

In the earlier measurements in this laboratory, the grid of the valve was not connected to the filament through a high resistance. X-rays were allowed to pass into the ionisation chamber for a suitable interval, generally 10 sec., and the charge collected on the insulated electrode was measured by the change in anode current of the electrometer triode. This is usually of the order of one microampere and may be measured directly by a galvanometer. This is the most sensitive method of using the valve.

Following Dr. B. W. Robinson, of the Davy-

the formation of chloric and perchloric acids, when the mist dissolves in water. As is well known, a similar red oxide, Cl_2O_6 , was also described by Bowen⁴, by Bodenstein, Harteck and Padelt⁵, and by Schumacher and Stieger² as formed by the interaction of chlorine dioxide and ozone.

It was found that the separation of this oxide was particularly marked at $0^\circ C.$ A quantity of the oxide was prepared at $0^\circ C.$ and the excess chlorine, ozone, and oxygen removed by a Hyvac pump while the vessel was cooled to $-10^\circ C.$

On warming the oxide it was then found that no constant vapour pressure was shown. On the contrary, a steady increase of pressure occurred, this being negligible at $1^\circ C.$ and becoming more and more rapid as the temperature rose. On cooling again to $1^\circ C.$, the original pressure was not regained, showing that an irreversible decomposition had occurred (Fig. 1).

We suggest that the phenomena noted by Heidt, Kistiakowsky and Forbes are explicable in terms of the separation of this oxide, which, according to our experiments, should have occurred under the conditions adopted by them, namely, high chlorine and ozone pressures and an initial temperature of $2^\circ C.$

The continued increase of pressure after the light was cut off noted by them, indicates the (thermal) decomposition of this oxide film; it is to be noted that, according to their experiments, this did not occur until after the gases had been illuminated for a considerable period, as is to be expected, according to this hypothesis.

We find a temperature coefficient of 2.34 per

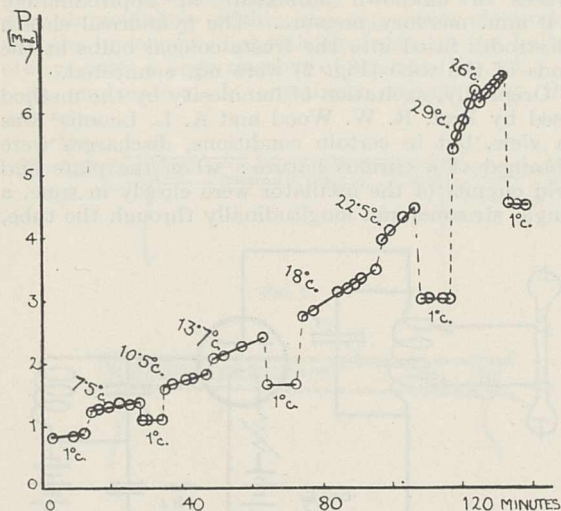


FIG. 1.

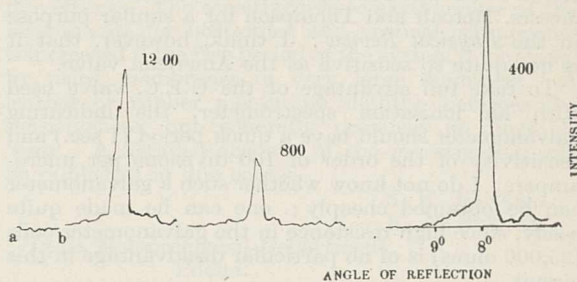


FIG. 1.

Faraday Laboratory, it is now the practice here to connect the grid to the filament by a high-resistance leak (pencil line on amber) in which case the steady deflection of the galvanometer measures the ionisation current. The anode current when no X-rays are entering the chamber is compensated by a potentiometer arrangement and the circuit is essentially the same as that given in the diagram of Mr. Teegan's letter.

For most measurements a semi-automatic recording device is used. The ionisation chamber is set at the required angle and the crystal rotated through the reflecting angle by means of a worm-driven wheel.

The same driver causes a drum carrying paper to pass under a pen which is moved by hand along guides parallel to the axis of the drum so that it follows the deflection of the galvanometer spot. The curves in Fig. 1 were obtained in this way: the ordinates, being the deflections of the galvanometer, measure the intensity of the reflected X-rays and the abscissae give the rotation of the crystal.

The curves were obtained by passing molybdenum $K\alpha$ radiation, filtered through zirconium metal, through a thin plate of gypsum so that orders (400), (800), (1200) could reflect at angles of 8° , 16° , 24° approximately. The crystal turns through 1° in 1.6 minutes and this corresponds to the paper moving forward by 2.8 cm. This enables measurements to be made much more quickly than was possible with the earlier arrangement. The steadiness of the zero is indicated by the line *ab*, which was obtained with the X-rays cut off, and the sensitivity may be estimated from the fact that the X-rays used for the curves shown produced a barely visible fluorescence in a darkened room on a barium platino-cyanide screen.

The apparatus is simple to set up and very reliable. Precautions must be taken to shield the valve electrostatically but the galvanometer need not be so protected. The total cost of the apparatus is less than that of the usual electrometer systems used for the same purpose.

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Feb. 25.

IN NATURE of February 25, Mr. J. A. C. Teegan proposed to apply the 'electrometer valve' now produced commercially by the G.E.C. to an X-ray ionisation spectrometer for the amplification of ionisation currents. It may interest him to know that such a valve has been in use for this purpose in this Laboratory for the past eighteen months with success, using a circuit identical in all essentials with that which he describes.

The G.E.C. valve is simpler in construction than the FP 54 plotron described some years ago by Messrs. Metcalf and Thompson for a similar purpose in the *Physical Review*; I think, however, that it is not quite so sensitive as the American valve.

To take full advantage of the G.E.C. valve used with an ionisation spectrometer, the indicating galvanometer should have a quick period (1 sec.) and sensitivity of the order of 100 divisions per micro-ampere. I do not know whether such a galvanometer can be obtained cheaply; one can be made quite easily, since high resistance in the galvanometer coils (25,000 ohms) is of no particular disadvantage in this circuit.

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Feb. 27.

High-Frequency Electric Discharge in Gases

IN October 1929, while using a radio-frequency oscillator of the tuned-plate/tuned-grid type (Fig. 1) for exciting the capacitive electrodeless discharge photographed by J. and W. Taylor¹ in gases at low pressure, I observed phenomena which have not, I believe, been elsewhere described.

The frequency employed ranged from 11.1 megacycles sec^{-1} to 21.4 megacycles sec^{-1} ; the valve was a power-oscillator of the VO 150 type with 1,800 volts anode potential supplied by accumulators, and the anode current ranged from 150 milliamperes to 160 milliamperes at these frequencies respectively. The anode inductance comprised three to four turns of 12 gauge wire, and to excite the discharge two wires were attached by clips to turns at opposite ends of the coil and their other ends were tightly bound round the ends of an ordinary positive column tube of about 18 cm. cylindrical length by 1.3 cm. internal diameter filled with neon with but slight traces of unknown admixture at approximately 8.0 mm. mercury pressure. The cylindrical sheath electrodes fused into the frusta-conical bulbs at the ends of the tube (Fig. 2) were not connected.

Originally, excitation of luminosity by the method used by Prof. R. W. Wood and A. L. Loomis² was in view, but in certain conditions, discharges were obtained of a curious nature: when the plate and grid circuits of the oscillator were closely in tune, a single streamer ran longitudinally through the tube,

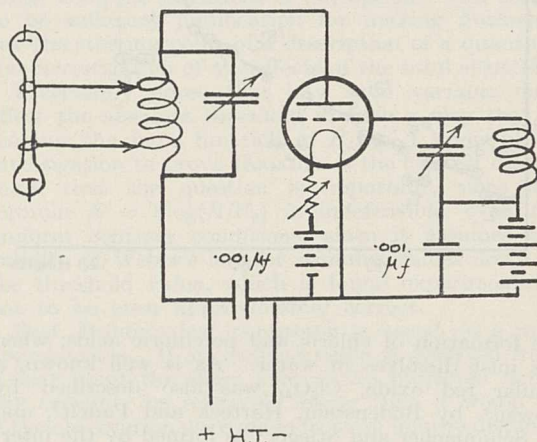


Fig. 1.

but instead of being straight and lying approximately along the axis of the tube, the streamer appeared bent somewhat into the shape of an elongated sine-wave of one complete cycle. When the frequency to which the grid circuit was tuned was slowly caused to diverge from that of the anode circuit, the streamer began to rotate at an accelerating rate about the axis of the tube, the sense of rotation depending upon the direction of divergence. At the same time, the streamer took on a helical conformation of one turn. With increasing divergence the speed of rotation increased until the whole tube appeared filled with glowing gas; with further divergence the discharge resolved itself into two inter-twined helical streamers revolving together but in the opposite sense to that of the single streamer. As the divergence continued to increase the angular velocity of the inter-twined streamers decreased to zero (Fig. 2), reversed and increased again until the tube was filled with a blur of light, and this cycle of phases was repeated with the periodic intercalation of an additional strand to the multiple streamer up to sixteen or seventeen strands, when they became difficult to count.

This discharge was exceedingly difficult to produce at will: usually the form was that shown in Fig. 3, in J. and W. Taylor's article, but by breaking and

making the anode supply circuit many times in succession, rotary streamers generally appeared. The distance between the capacitive electrodes was immaterial to inception and appearance, and orientation of the tube with respect to the coil or to a permanent magnet appeared to be without sensible effect. Once started, the discharge was extremely stable, and the envelope temperature was of the order of 40°–50° C.

Occasionally, only about half the distance between the external electrodes would exhibit rotary streamers while the remainder would contain a stationary, co-axial, thicker column (Fig. 3). A rotary discharge also occurred more frequently between the bright rings immediately within the capacitive electrodes and the unconnected sheath electrodes in the bulbs, always with a large number of strands (Fig. 4).

In explanation, I tentatively suggest that the

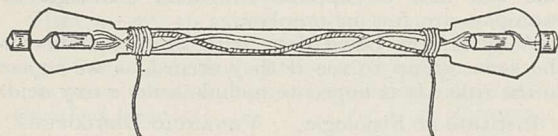


FIG. 2.

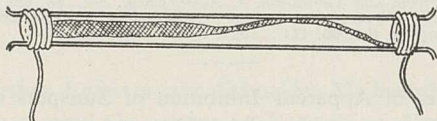


FIG. 3.

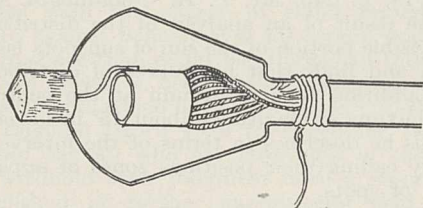


FIG. 4.

electronic displacement current and the corresponding equivalent accelerating potential difference between two points in the gas (between which the displacement current is drifting) are out of phase to an extent depending upon the divergence of natural frequencies of tuned-grid and tuned-anode circuits of the oscillator, and the result is that an electron if it were originally at rest within the tube would describe, in the absence of collisions, a zig-zag path round an annulus inside the walls; the net effect of a large number of electrons doing this gives in general a rotary helical locus of maximum electronic velocity (and therefore of ionisations-by-collision). The suggested effect of phase difference, though a purely *ad hoc* supposition, would appear to be substantiated to a certain extent by equations (7) and (8) given by Darrow in a recent paper on "High Frequency Phenomena in Gases"³.

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¹ *Exp. Wireless and Wireless Eng.*, 5, 60, 503; 1928.

² *NATURE*, 120, 510, Oct. 8, 1927.

³ *B.S.T.J.*, 11, 4, 584; 1932.

Hydraulic Seismographs

PROF. KAPITZA has described¹ a balance for the measurement of magnetisation in which he makes use of hydraulic magnification and damping in a very ingenious manner and suggests that the same method may be adopted for the construction of seismographs. In order to explore the possibilities of this type of instrument for the recording of earthquakes a series of comprehensive experiments was carried out by us in the Colaba Observatory.

The apparatus for the recording of the vertical component consists of an inverted cylindrical cup, its lower horizontal face being closed by a thin metal diaphragm and a narrow open tube being attached horizontally fitting a hole in the side in which a mirror is suspended from a horizontal axle. A cylindrical jacket covers the cup all round except the diaphragm at the bottom. A highly viscous oil is then poured into the double chambers, so as to fill up completely the inner chamber, and the diaphragm is then loaded by attaching a weight of 1 kgm. or more to a rod fixed at its centre. The vertical component of the ground movements sets up oscillations in the diaphragm and forces the oil to move to and fro through the narrow tube, and this gives a large oscillatory angular motion to the mirror which is recorded photographically. With a tin diaphragm of thickness 0.019 cm. and diameter 15 cm. loaded with 1 kgm., a period of 2.3 sec. and a damping ratio of 5:1 were obtained when the instrument was filled with castor oil.

The low free period of the system does not make the instrument very sensitive to earthquake waves. It is, however, highly sensitive to artificial vibrations of the ground and gives also good records of the sustained vibrations, such as microseisms. Being a compact and fully assembled portable instrument it should form a valuable equipment for geophysical prospecting.

If the chambers be so arranged that the membrane is in the vertical plane and is loaded with two symmetrical weights fixed at both ends of a horizontal rod passing through its centre, the instrument records the horizontal component of the ground movements. The sensitiveness to earthquakes of the instruments for horizontal and vertical components is increased if the free period of the system is increased by using membranes of very large diameters. A leather or rubber membrane slightly increases the sensitiveness, but generally produces an unstable 'zero'. A detailed account of the investigation will be published in due course.

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Feb. 20.

¹ *Proc. Roy. Soc., A*, 131, 224-242; 1931.

Reversal of Current in Rectifier Photo-Cells

WE have noted with interest Mr. Guild's observations on this effect, as recorded in *NATURE* of March 4. In reply to his query, the values given for the relative sensitivities were for an "equal energy spectrum", being obtained by direct comparison with a Moll vacuum thermopile for the different spectrum regions. Any other method of presentation would obviously be valueless, as the energy flux reaching

the cell increased rapidly with the wave-length. The maximum reverse current obtained from the marginal regions of the cell was no less than 28.5 per cent of the maximum direct current obtained for the same regions.

We should like to take this opportunity of apologising to Dr. P. Auger and M. C. Lapique for having overlooked the section of their paper¹ in which they briefly mention the reversal phenomenon, and give its explanation, identical with the one since given by us and by Mr. Guild. Dr. Auger also studied the spectral transparency of such gold and silver films, as Mr. Guild is now doing; from this he deduced the true variation in the spectrum of the photo-electric properties of cuprous oxide, since the curves given by gold and silver film cells were identical when corrected for the transmission of the film. The transmission of cuprous oxide films has been studied by L. Dubar², who investigated also the temperature coefficient of the cells up to 60° C. Dubar³ has also studied the peculiar constitution of the cuprous oxide layer.

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Royal Dublin Society.

W. R. G. ATKINS.

Marine Biological Laboratory,
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March 11.

¹ *C. R. Acad. Sci. Paris*, 193, 320; 1931.

² *Loc. cit.*, 193, 659; 1931.

³ *Loc. cit.*, 194, 1332; 1932.

A Rule for the Rotatory Direction of the Acetylated Aldonic Nitriles

DURING research on some sugar derivatives, the rotation in chloroform of their acetylated aldonic nitriles was determined, and the following results were obtained:

tetra-acetyl <i>d</i> -xylic nitrile,	$(\alpha)_D^{22} = +50.3^\circ$;
tetra-acetyl <i>l</i> -arabonic nitrile,	$(\alpha)_D^{22} = +4.2^\circ$;
penta-acetyl <i>d</i> -galactonic nitrile,	$(\alpha)_D^{22} = +48.4^\circ$.

From a search in the literature, the rotations determined for other nitriles were found to be:

penta-acetyl <i>d</i> -gluconic nitrile ^{1,2} ,	$(\alpha)_D^{22} = +46.2^\circ; +48.0^\circ$;
hexa-acetyl <i>d</i> -gluco- α -heptonic nitrile ⁴ ,	$(\alpha)_D^{21} = +24.6^\circ$;
hexa-acetyl <i>d</i> -manno- α -heptonitrile ³ ,	$(\alpha)_D^{20} = +31.4^\circ$;
penta-acetyl <i>d</i> -mannonic nitrile ² ,	$(\alpha)_D^{20} = -1.4^\circ$;
penta-acetyl <i>l</i> -rhamno- α -hexonic nitrile ³ ,	$(\alpha)_D^{20} = -76.4^\circ$.

The following data were found for non-acetylated aldonic nitriles:

gluconic nitrile ⁴	$(\alpha)_D^{21} = +8.8^\circ$;
<i>d</i> -manno- α -heptonic nitrile ³ ,	$(\alpha)_D^{20} = +23.1^\circ$;
<i>l</i> -rhamno- α -hexonic nitrile ³ ,	$(\alpha)_D^{20} = -23.4^\circ$.

When the figures and signs of rotation of the acetylated nitriles are compared, it is seen that a new rule similar to the well-known amide or phenylhydrazide rules of Hudson for aldonic acids, can also be formulated for the acetylated nitriles of the same acids.

When the configuration of the 2-carbon atom is considered, it follows that nitriles in which that atom has the configuration $\text{H}\overset{\text{O}}{\text{C}}\text{O}\cdot\text{COCH}_3$ (that is, $\text{H}\overset{\text{O}}{\text{C}}\text{OH}$ in the primitive monose, employing Fischer's projection formula) rotates to the right, as is found in *d*-xylic, *l*-arabonic, *d*-galactonic, *d*-gluconic, *d*-gluco- α -heptonic, and *d*-manno- α -heptonic acetylated nitriles.

When the configuration of the 2-carbon atom is reversed: $\text{CH}_3\text{CO}\cdot\overset{\text{O}}{\text{C}}\text{H}$ (that is, $\text{HO}\overset{\text{O}}{\text{C}}\text{H}$ in the primitive monose) the nitriles rotate to the left, as in *d*-mannonic, and *l*-rhamno- α -hexonic acetylated nitriles. It follows that the sign of rotation of the nitriles will be the same as that of the amides and phenylhydrazines of the same acids. It is of no use, however, to make comparisons between the rotatory values of the acetylated nitriles and the amides or the free acids, owing to the different solvents employed in each case.

The theoretical foundations of the nitrile rule are the same as those for the amides or the phenylhydrazides, and have been explained by Kuhn and Freudenberg. Only exaltation of the individual asymmetric carbon atoms must happen owing to acetylation of the alcoholic hydroxyls. When the free nitriles are considered, it is seen that perhaps the rule can also be applied to them, although the examples are few in number.

Work is now being done with other members of the same group to see if they accord, as we expect, to the rule. It is hoped to include some α -oxy acids.

Instituto de Fisiología, VENANCIO DEULOFEU.
Buenos Aires.
Jan. 16.

¹ Zemplen and Kiss, *Ber.*, 60, 165; 1927.

² Wolfson and Thompson, *J. Amer. Chem. Soc.*, 53, 622; 1931.

³ Mikšić, *Chem. Zentr.*, 1, 2704; 1928. *Chem. Abs.*, 23, 2941; 1929.

⁴ Zemplen, *Ber.*, 60, 171; 1927.

Zones of Apparent Inhibition of Sunspots on the Solar Disc

IN a recent paper¹ referred to in NATURE of February 18, p. 245, Mr. P. R. Chidambara Aiyar reports the result of an analysis of the distribution over the visible portion of the sun of sunspots lasting two days, and finds that his curves of distribution show, in addition to a maximum at the centre of the disc, maxima at longitudes about 15° inside either limb. This he describes in terms of the intervening minima by calling their positions zones of apparent inhibition of spots.

It is to be expected that the number of spots of any given size or period observed, in an assigned number of degrees of longitude, would show a steady diminution from centre to limb simply on account of foreshortening rendering the spots less visible. The minima noted by Mr. Aiyar can scarcely have a physical significance since the co-ordinates used (apparent longitude on the solar disc) have no physical meaning for the sun, being fixed on any day by the position of the earth in its orbit on that day.

Mr. Aiyar has established that his results are not due to random variations in the data, and accordingly a cause lying in the mode of selection of the data is to be sought. I wish to point out that the explanation of the inhibitory zones is to be found in the following reason for the existence of the maxima near the limb, and that there is in fact no region of scarcity, but merely a spurious region of richness.

In selecting the spots, only those are used which are observed on two days, but not on three or more. If the whole surface of the sun were visible this selection would operate uniformly in all solar longitudes, but in fact only the region from -90° to +90° is visible at any one time, and this leads to an excessive count near the limb. Owing to the rotation

of the sun, a spot travels about 15° per day, so that all spots between longitudes -60° and $+60^\circ$ are observable during two days or more; hence all spots occurring in this region are excluded from the count if their life exceeds two days, while spots in the remaining regions are observable for two days or less. Taking -90° as the limb of the sun which is rotating towards the earth, all spots classified as two day spots between about -90° and -60° may in fact have had any life up to about 16 days, and similarly all spots classified as two day spots between about $+60^\circ$ and $+90^\circ$ may have a life of from two days up to about 16 days, that is, in either zone half a revolution period of the sun plus rather more than two days. Actually the limits 60° and 90° must be replaced by somewhat smaller values to allow for the loss of spots by foreshortening, and in any event the foreshortening conquers at the limb where the number must finally fall off.

Thus we are to expect spurious maxima at about $\pm 75^\circ$ due to this selection, and this is precisely where Mr. Aiyar finds his extra maxima.

A more detailed numerical investigation will be described later.

J. A. CARROLL.

The University,
Aberdeen.
March 8.

¹ *Mon. Not. R.A.S.*, 93, 150; 1932.

Further Light on the Schneider Mediumship

I HAVE read the review in NATURE of April 8 of Mr. Harry Price's "An Account of some Further Experiments with Rudi Schneider". To deal in detail with the charge of fraud brought by Mr. Price against Schneider in his report would take up more space than could be afforded in these columns. I have, however, been closely associated with all the experiments which have been made with this medium in England (April 1929 to December 1932), and I would ask all who are interested in these matters to withhold their judgment until a report has been published of further experiments held with this medium (October to December 1932). These further experiments were carried out in as scientific and impartial a manner as circumstances permitted and the results supplied strong indications that Schneider indeed possesses genuine 'supernormal faculties'.

In reply to the suggestion put forward in the review in question that the presence of a supposed accomplice invalidates Dr. E. Osty's report "Les Pouvoirs Inconnus de l'Esprit sur la Matière"—a report of careful experiments with the same medium, 1930-1931—it appears that the attempts of trickery in question were of a puerile order and in no way affected the main issue. The infra-red ray apparatus and objects subjected to telekinesis were completely separated from the medium and sitters by a clamped gauze net, 5 feet 6 inches high, and none of the attempts at trickery affected any phenomena on the far side of the net. Out of a total of ninety séances held by Dr. Osty, the suspect attended only fifteen, of which seven were blank and at none was telekinesis reported.

It should be noted that Mr. Price did not notify his Council or any of his invited sitters of (1) the existence of the incriminating photograph, (2) the friendly warning of Dr. Osty with regard to the suspect who, however, was allowed by Mr. Price to attend all the séances arranged by him.

It is hoped to carry out still further experiments with the same medium later this year, when various improvements will be adopted concerning both the technique of the séances and the scientific apparatus employed.

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C. M. HOPE.

Tracheal and Blood Gills in Aquatic Insect Larva

AMONG the larvæ of aquatic insects, two fairly well-defined types of gill-like structures are commonly found—'tracheal gills' and 'blood gills'. The former term is applied to thin plates or filaments with a copious tracheal supply and only a very small blood cavity, structures which are typically developed in such insects as Ephemeroptera and Trichoptera. The term 'blood gill' is restricted to organs which have a spacious lumen but in which tracheæ are poorly developed or totally absent; the ventral and anal gills of *Chironomus* being a familiar example. The work of Fox¹ on *Chironomus* gave rise to doubt as to the respiratory function of blood gills in general, doubt which has been strengthened by the confirmatory work of Harnisch², and in a recent series of papers Wigglesworth³ describes experiments upon the anal gills* of the larva of the yellow-fever mosquito (*Aedes (Stegomyia) argentatus*), from which he concludes that the main function of these structures is the absorption of water and that they are of little value as organs of respiration. Since in this species they are much larger than in the majority of allied forms, it is probably safe to assume that in the Culicidæ as a whole, anal gills are of little importance from the point of view of respiration: a conclusion which is confirmed by my own experiments on *Culex* spp.

In view of these results, it seems opportune to give a brief summary of experiments on blood gills and tracheal gills in other aquatic larvæ which I have carried out, a preliminary account of which is already in the press⁴. The technique employed was similar to that described in a previous paper⁵. In the case of the rectal blood gills of Trichoptera, it was not possible to detect any respiratory function, and similar results were obtained with the rectal gills of *Simulium*, *Corethra*, etc. One can therefore state that in no case has it been shown that the blood gills of aquatic larvæ serve any useful function in respiration. While there remains the possibility that these structures may come into play only within certain limits of oxygen tension, it may be said that the work of Harnisch gives no support to this hypothesis even in that form (*Chironomus*) in which it would appear most probable.

As might be expected, experiments with tracheal gills have yielded different results and have shown that these organs are undoubtedly active in respiration. But it has long been known that the larvæ of Agrionid dragon-flies can survive for a considerable period in the absence of caudal lamellæ and Cuenot⁶ showed that the tracheal gills of certain Ephemeroptera (*Ephemerella*, *Chloeon*) can be removed without causing the death of the insect. In the Agrionids, the existence of general cutaneous respiration is easily demonstrated and my observations have shown that cutaneous respiration is also very prevalent among Ephemeroptera (*Chloeon*), Trichoptera (*Limnophilus*, *Anabolia*, *Leptocera*), Coleoptera (*Gyrinus*) and Neuroptera (*Sialis*), although in every case the tracheal gills are undoubtedly acting more

or less efficiently. Since these observations were made, it has been shown⁷ that the gills of the Ephemeroidea *Hexagenia recurvata* are not essential to life in the winter months and that⁸ even the elaborate gills of the Caddis *Macronema zebratum* are superfluous: the insect being capable of completing its life history without them.

In certain genera of Plecoptera tracheal gills are poorly developed and in some instances, by no means small forms, they are lacking altogether, so that gaseous exchange takes place entirely through the general body surface. Experiments with larvæ of a species of *Leuctra* which lacks tracheal gills entirely showed that respiration proceeds most rapidly at the ventral surface of the thorax and the bases of the legs, the indicators being affected later at the 'neck' and at the anterior region of the abdomen. In view of this, it is interesting to note that an American species of *Nemoura* has been described⁹ as having the walls of the femora richly supplied with tracheæ as if to serve as a gill.

Tracheal gills are rare among dipterous larvæ. Such gills with a large tracheal supply occur in Tipulids (for example, *Pedicia*) and in the curious larvæ of the Pantophthalmidæ, but in each case open spiracles are present, and although the gills have been shown¹⁰ to be the site of very rapid gas exchange compared to the rest of the body, it is known¹¹ that the larva (*Pedicia*) cannot long survive occlusion of the spiracles. They are at best a rather unimportant accessory means of respiration.

To sum up, it can be said that the blood gills found in aquatic insect larvæ are practically negligible so far as respiration is concerned, and to this extent the conclusions of Wigglesworth are supported. Certain types of tracheal gills, on the other hand, may be very efficient. But they are by no means the sole organs of respiration and even where highly developed, may be secondary in importance to the general body surface; under experimental conditions the animal can often do without them for long periods if not altogether.

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Feb. 20.

* Owing to their small tracheal supply and relatively large blood space the anal gills of mosquito larvæ are here classed as 'blood gills' rather than 'tracheal gills'.

¹ Fox, H. M., *J. Gen. Physiol.*, 3, 565; 1920.

² Harnisch, O., *Z. Vergl. Physiol.*, 11, 285; 1930.

³ Wigglesworth, V. B., *J. Exp. Biol.*, 10, 1, 16, 27; 1933.

⁴ Thorpe, W. H., Proc. IV Int. Congress Entom. Paris (in press); 1933.

⁵ Thorpe, W. H., *Proc. Roy. Soc.*, B, 109, 450; 1932.

⁶ Cuenot, "L'Adaptation", Paris; 1925.

⁷ Morgan and Grierson, *Physiol. Zool.*, 5, 230; 1932.

⁸ Morgan and O'Neill, *Physiol. Zool.*, 4, 361; 1931.

⁹ Wu, C. F., Bull. Lloyd Library, 1923.

¹⁰ Thorpe, W. H., in press (1933).

¹¹ Oldham, J. N., *Proc. Roy. Phys. Soc.*, 21, 33; 1926.

Earthquakes in the Holy Land: A Correction

In an article on earthquakes in the Holy Land¹ there is given a list of 207 shocks, of which there is record, between the years 1606 B.C. and A.D. 1927. Among these are 27 dates from an Arabian authority, As-Soyuti, whose work appears in translation in the *Journal of the Asiatic Society of Bengal*. In transcribing these dates I failed to observe that they were stated as A.H., that is, *Anno Hejira*, instead of *Anno Domini*. They are, therefore, as quoted in my list something over six centuries too early. The corrected dates are as follows:

A.H.	A.D.	A.H.	A.D.	A.H.	A.D.
94	712	434	1042	552	1157
98	716	455	1063	565	1169
130	747	460	1067	575	1179
220	835	462	1069	578	1182
233	847	479	1086	597	1200
242	856	484	1091	600	1203
245	859	532	1137	702	1302
393	1002	533	1143	791	1388
425	1033	551	1156	889	1484

Inasmuch as the Hejira dates from July 622 A.D. and there are adjustments of the calendar dates for fractions, these figures may be off one year. It is also probable that the original dates are approximate. Hence where As-Soyuti differs by a year from others given in the list as published, one shock only is presumably meant.

In this connexion I would direct attention to a very ancient, yet definite observation regarding the now well-known earthquake fault that traverses the eastern slope of the Mount of Olives:

"And His feet shall stand . . . upon the mount of Olives, which in that day is before Jerusalem on the east, and the mount of Olives shall cleave in the midst thereof toward the east and toward the west, and there shall be a very great valley; and half of the mountain shall remove toward the north, and half of it toward the south."²

Activity on this fault was the occasion of destructive tremors in 1927. That it was the scene of more obvious displacement some 2,500 years earlier we cannot doubt in view of the graphic description of the Old Testament writer, although his identity and the exact date of his prophecy are matters of uncertainty, especially with reference to this particular passage.

BAILEY WILLIS.

Stanford University,
California.
March 6.

¹ *Bull. Seismol. Soc. America*, 18, 1928.

² Old Testament, *Zechariah*, 14, 4, 5, 20 B.C.

A Numerical Coincidence

IN "The Expanding Universe" Sir Arthur Eddington refers to the *fine-structure constant*, which appears to be a fundamental in the modern physics of which he treats, as a pure number the value of which is close to, if not exactly, 137, and in a later passage he writes: "nature's curious choice of certain numbers such as 137 in her scheme."

There is no indication that Sir Arthur includes the following facts in his thesis but it is undoubtedly the case that the number 137 is remarkable because it is the logarithm of itself, or, to be more precise, 13713 is the mantissa to five decimal places of the logarithm of 13713. Also the reciprocal of 13713 used as circular measure is the value of the usual symbol for the rate of rotation of the earth, it being the angle through which the earth turns in one second of mean solar time.

These things are mentioned as an interesting coincidence in an excellent but perhaps little known book, "A Few Chapters in Astronomy", by Claudius Kennedy, first published in 1894. The resemblance of this salient number to one in a very different connexion may well be taken as an example of Nature's whimsicality.

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March 13.

Research Items

Age of Maglemose in Britain. The evidence for dating the three Maglemose harpoons, which have been found in Britain, by means of the pollen deposits in peat, is discussed by H. and M. E. Godwin in *Antiquity* for March. Of the two harpoons from Holderness in Yorkshire, the Skipsea example was found below 5 ft. of peat with remains of reindeer and an *Ancylus* fauna. Samples of the peat deposit, which is 7 ft. thick with brown sandy silt below, show an immigration and rise of *Alnus* with a diminishing *Pinus*, a high initial percentage of *Corylus*, falling rapidly, but with a pronounced secondary maximum, a small percentage of *Salix* and *Tilia*, and *Ulmus* and *Quercus* showing high percentage values in the lower samples. These conditions are characteristic of the Boreal period, the actual site of discovery being late Boreal. A 'moorlog' sample trawled from the North Sea between the Leman and Ower banks off the coast of Norfolk, the point from which a Maglemose harpoon was trawled in the summer of 1932 [this should be September, 1931], showed an absence of alder, a virtual absence of elm and an absence of oak from the basal sample, and suggests that this harpoon is rather older and of early Boreal age. The attempt to obtain samples of peat from the Hornsea site in Holderness, from which the second of the Yorkshire specimens came, was unsuccessful. Turning to analogous finds on the Continent, the artefacts from Kunda in Esthonia came from a layer of 'bleke', a fresh-water calcareous deposit of the Kunda sea, overlying clay with sub-arctic plants and *Betula*, *Pinus* and *Salix*. The Kunda artefacts can be dated with certainty as of Boreal age and correlated with the *Ancylus* maximum. The *Pinus* maximum and fall, the diminishing *Betula*, the increasing *Alnus* and the immigrant *Ulmus*, with *Quercus* not yet present, characterise the Boreal period for the more northerly parts of Europe. Forest development seems to have been synchronous in Esthonia, Denmark and England and the Maglemose cultures of each were approximately contemporaneous.

Saharan Rock-Engravings. "L'Adrat Ahnet: Contribution à l'Étude archéologique d'un District Saharien" (*Tr. et Mém. de l'Institut d'Ethnologie*, Paris, T. 19) by Dr. Th. Monod contains, *inter alia*, the results of an examination of a large number of rock engravings and inscriptions. These have been recorded on thirty-six sites, of which the author has visited twenty-nine. The problem of the age of these engravings, in default of data, seems insoluble. A certain criterion of relative age is afforded by the weathering of the engraved lines; but this ceases to be an indication when once they have toned down to the tint of the surrounding surface of the limestone. It does not seem possible to relate the engraving with certainty to the chronological and classificatory schemes suggested for the rock engravings of Northern Africa, especially as these are not themselves convincing. The only classification that appears possible is into two groups according to the subjects:—(1) a pre-camel bovidian group and (2) a camel (equine) group. Of these the first is the older and the artists might well have been the ancient agricultural black population of the Sahara, possibly neolithic; while the second might have been exclusively Libyo-Berber and historic. The first group is characterised by a

remarkable profusion of Bovidae and by typical African fauna, elephants, giraffe, rhinoceros (?); but neither camel nor horse is present; human figures are without the 'Libyan forelock' and are armed with bows and throwing-knives (?). The engravings have a dark patina. The bow, often shown on South Algerian engravings, is possibly an Ethiopian characteristic. In the second, the camel group, there are no elephants or giraffe (?), camels and horses appear, and the human figures show the 'Libyan forelock' and are armed with a round buckler, three javelins with metal tip and a sword which hangs from the buckler arm. Many show marked steatopygia. The patination is light in colour.

Distribution of Birds of the Russian Altai and north-west Mongolia. A posthumous paper by P. Sushkin has recently been published (*Bull. Soc. Nat. Moscou*, 41, Nos. 1-2) in view of the increasing trend towards mid-Siberian investigation. A description of the topography and vegetation of the area precedes a list of 373 species and sub-species of birds, tabulated according to district and the nature of their stay. Excluding occasional species, about ninety per cent of the forms are classed as 'nesting'. Conclusions are drawn as regards the division of the territory in relation to its fauna. In addition, 26 new, probably new, and imperfectly known sub-species are described in both Russian and English. The contribution gains additional importance from the fact that the author considered the list practically exhaustive for the area. It is to be regretted that lack of space made it impossible to include the entire work, with photographs, etc.

Worms parasitic in Cetacea. Dr. H. A. Baylis has compiled a useful catalogue of the parasitic worms of Cetacea ("Discovery" Reports, 6, 393-418; 1932). The first section of the work includes a list of the parasites, in which are given the synonyms of each species, the hosts from which they have been recorded, and references to the principal publications in which the species are described or discussed. The recorded species of trematodes are eighteen, of cestodes sixteen with three which can only be placed generically, of nematodes twenty-four besides two larval forms and one doubtful species, and of *Acanthocephala* seven species and two worms only generically determinable. The second part of the work consists of a list of hosts with the parasites recorded from each and is followed by a bibliography.

Spider Crabs from Japan. Eleven species of Japanese Oxyrhyncha belonging to ten genera are described by Dr. Tsune Sakai in the Science Reports of the Tokyo Bunrika Daigaku, Section B., No. 4, 1932; Zoological Institute, Tokyo University of Literature and Science ("Notes on some Rare Materials of Japanese Oxyrhyncha"). New information on some rare forms is given, two of the species are new and five are recorded for the first time from Japan. Most of them are inhabitants of Indian and tropical seas. *Halicarcinus orientalis* n.sp. is peculiarly interesting because this genus is usually found in the southern hemisphere only. The second new species, *Archæopsis rostrata*, is closely allied to *A. thomsoni* but has much

broader rostral horns which are more prominent than any known species of the genus. All these crabs vary greatly and a good series of specimens was available in most of them, thus linking up the extreme forms which might have been regarded as separate species. The full-grown male of *Navia hystrix* is described for the first time, the previous descriptions being mainly from young females. Young and adults of both sexes were abundant and showed very important differences both with regard to the sexes and in development. The carapace in the adult is globular but in the young it is longer than broad, and the rostral horns in the adult are much shorter in proportion to the carapace than they are in the young.

Hybrid Bananas. The search for a banana which is immune to Panama disease is leading to interesting results. At the Imperial College of Tropical Agriculture, Mr. E. E. Cheesman is making genetical studies of bananas, and some of the results are reported in two recent papers (*J. Genetics*, vol. 26, No. 3). As the cytological findings are of much interest, it is hoped that the fixation may be somewhat improved. Previous workers have concluded that the chromosome numbers in cultivated bananas were multiples of 8 or 4, but Mr. Cheesman finds that 11 is probably the basal number, though secondary pairing in meiosis indicates that this may have been derived from an original eight. The sterile and parthenocarpic Gros Michel banana is found to be triploid ($2n = 33$). When pollinated by a diploid variety of *Musa malaccensis* ($2n = 22$) a few seeds are formed, less than one in a hundred flowers. From such seeds ten plants were raised, eight of which were like the female parent and had $2n = 44$ chromosomes. The other two were thick-leaved, sterile dwarfs with about 75 chromosomes. One of the F_1 plants with 44 chromosomes differed from the rest in being immune to Panama disease. This plant (*I.C.1*) showed a high degree of self-incompatibility when selfed, but yielded five offspring, three of which had 44 chromosomes and two 46. Attempts to cross Gros Michel with the pollen of the immune plants yielded one seedling only, which had about 39 chromosomes. The F_1 back-crosses, however, readily with the original male parent, giving vigorous plants having 33 somatic chromosomes. The Mysore banana, which appears to be immune, and has $2n = 33$ chromosomes, was also pollinated by *M. malaccensis* and yielded more seeds. Nine F_1 hybrids were raised. Six of them resembled the female parent and had $2n = 44$ chromosomes, two were thick-leaved dwarfs like those of the Gros Michel cross, and one with $2n = 33$ was intermediate between the parents. Mysore \times *I.C.1* gave two plants, both thick-leaved. One had $2n = \pm 55$ chromosomes, and the other, a dwarf, ± 90 . Several other mutant types of dwarf bananas from various sources are briefly described in *Tropical Agriculture*, vol. 10, No. 1.

Motion of a Cone at High Speeds in Air. When a body moves through air at a uniform speed greater than that of sound, it is well known that a 'shock' wave is produced which moves with the body. This wave is very characteristic of photographs of flying bullets. Taylor and Maccoll have given (*Proc. Roy. Soc.*, Feb.) a solution of the hydrodynamical equations which satisfies the condition that the flow is irrotational and that the surfaces of constant pressure, constant velocity and constant density are cones coaxial with the projectile and have the same vertex. The solution

was obtained by numerical integration and was used for calculating the pressure at the surface of the cone and the shape of the shock wave. It is found that the conical regime is only possible for projectile velocities above a critical value, which is 1.46 times the velocity of sound for a 60° cone. The theory was tested by measuring the pressures at the surface of cones mounted in the high-speed wind tunnel at the National Physical Laboratory and satisfactory agreement with calculation was obtained. Photographs of flying, conically-nosed bullets were made at Woolwich which showed the breakdown of the conical regime at low speeds. At high speeds the shock wave was a true cone in contact with the vertex of the bullet, while at lower speeds the wave has a curved nose and travels ahead of the bullet.

Predictions of Nuclear Moments. Almost as soon as the neutron was discovered, it was suggested by various authors that the neutron must be a constituent of other nuclei, and it is now generally realised that the well-known difficulties with respect to the nuclear moment and statistics of nitrogen, etc., can be avoided, if the neutron be assumed to have half a quantum of angular momentum, and to obey the exclusion principle. In two recent papers in *Current Science* (Nov. 1932 and Feb. 1933), Prof. B. Venkatesachar and T. S. Subbaraya have applied this model to make more detailed predictions of nuclear moments. They assume that all the protons combine with neutrons to form α -particles, except for an odd proton if the atomic number is odd; the remaining neutrons arrange themselves in levels in the same way as the planetary electrons in an atom. The several possible values of the nuclear moment j may be written down in each case. The values of j determined from the hyperfine structure and from the band spectra are shown to be in agreement with one of the calculated values, except in a few cases.

Measurement of X-Ray Tube Current and Voltage. G. W. C. Kaye and G. E. Bell of the National Physical Laboratory read a helpful paper on the measurement of X-ray tube current and voltage to the Institution of Electrical Engineers on March 30. From the point of view of the X-ray worker, measurements of tube current and of exciting voltage are only a means to an end. They help him to form an estimate of the amount and quality of the radiation he is using. In the case of two types of commercial X-ray tubes—the Coolidge and the Metalix—they found that the output was proportional to the product of the current by the n th power of the peak voltage. In the case of unfiltered radiation from a tube with a thin window n was about unity, but for heavily filtered radiation n might be so great as five. The various types of valve rectification circuits suitable for X-ray work were discussed. It is proved that for like values of peak voltage and milliammeter readings for full-wave and half-wave rectification, the radiation outputs are the same over a pressure range from 40 to 80 kilovolts. The output for constant voltage is about 1.8 times greater. From the radiation point of view the essential factors of voltage excitation are the peak value and the form of the wave. The several methods of measuring high voltages are dealt with in detail. It is pointed out that the moving-coil ammeter customarily employed only indicates the mean current and not the maximum current through an X-ray tube excited by a pulsating voltage. It is concluded that while the moving-coil

ammeter is adequate for the measurement of sustained tube currents, it is best to use some form of ballistic meter for currents lasting less than about a second.

Structure of Cellulose. One of the difficulties in correlating the physical and chemical properties of cellulose is the peculiar, almost self-contradictory, nature of this substance. Thus, the tensile strength of an artificial silk fibre may correspond weight for weight with that of a wire made from a light metal such as duralumin, although so far as transparency and conductivity of electricity and heat are concerned, cellulose has no semblance of metallic properties. A combination of X-ray and chemical methods will probably ultimately provide the explanation of these difficulties, and it is from this point of view that Prof. M. J. Duclaux describes the results of recent work on the subject in *La Papeterie* (Nos. 18 and 19; 1932).

The X-ray diagrams are best explained on the assumption that the greatest length of the cellobiose molecule is equal to that of the crystal lattice (10.3 Å). This, in fact, is the foundation of the theory proposed by Mark and Meyer, namely, that the lattice takes the form of an oblique prism, and it involves the orientation of a cellobiose molecule at each corner and one joining the horizontal faces; two such molecules would then be common to each of four continuous lattices. Opposed to this is Staudinger's suggestion that the cellobiose molecules may form a long chain, and this is supported by the progressively increasing viscosity and decreasing solubility of chain complexes built up from simple molecules. One is left with the impression that the arguments in favour of each type of structure are equally potent, but that once the question of the length of the chains is settled a big step will have been taken in the direction of a solution of the problem.

Astronomical Topics

Occultation of Regulus on April 6. Extensive preparations were made to observe this occultation at stations near the northern boundary, which crossed England from Liverpool to Dover. Both in the neighbourhood of Canterbury and in that of Hitchin, parties of astronomers occupied posts about a mile apart along lines at right angles to the boundary; but clouds prevented any useful results from being obtained. The only time-observation to hand was made by Rev. O. Walkey at St. Buryan, Cornwall; long. $5^{\circ} 36' 18''$ W., lat. $50^{\circ} 4' 58''$ N.; in a letter to the *Morning Post* he gave the time of disappearance as $20^{\text{h}}35^{\text{m}}23^{\text{s}}$ U.T., but did not give the time of reappearance, though he stated that the star was hidden for 45^{m} , which is the maximum for any point in the British Isles. The phenomenon was seen as a spectacle from Worthing, but no times were recorded. It is worth while to remind the public that they can do useful work by timing the disappearance of stars, using the wireless time-signals to find the errors and rates of their clocks. The times must be given to seconds, and the position of the station determined from a large-scale ordnance map.

A Remarkable Short-Lived Nova. A photograph taken at Uccle by MM. Delporte and Arend on the evening of March 20 showed an image of a star of magnitude 13.2 (the first announcement gave mag. 11.0, but this was corrected to 13.2) of which no trace could be seen on earlier plates, one of which was taken in 1927, four in 1932 and one on March 18, 1933; this last showed stars to mag. 17.0. The position of the star for 1933.0 is $7^{\text{h}}18^{\text{m}}29.13^{\text{s}}$, N. $28^{\circ} 38' 1.7''$. The following further observations were made at Uccle on the evenings of the dates named: March 21, mag. 13.5; March 22, mag. 14.5; March 23, mag. 17.0; on March 24 it was invisible, but the observing conditions were bad (U.A.I. Circs. 430, 431, 432). Further information is contained in Harvard Cards 264 and 265; the star was not found on Harvard plates taken on March 17 and March 22, which show stars to mag. 12; but plates taken by Prof. G. van Biesbroeck with the 24-inch reflector at Yerkes show it of mag. 14.5 on March 23-17 U.T., and of mag. 16.5 on March 24-19 U.T. The rapid rise and fall is thus confirmed. The star would seem to belong to a different category from ordinary novæ; also long-period variables generally remain

at maximum for several days. The region should be scrutinised from time to time in case of a reappearance.

Report of the Director of Leyden Observatory for 1932. This report gives evidence of a large amount of valuable work carried out not only at Leyden but also at Johannesburg, at an equatorial station in Kenya, and at the Perkins Observatory in Ohio. At the latter station Dr. Oort received permission to take a number of plates of extragalactic nebulae with the new 69-inch reflector; these are to study the surface luminosity and the distribution of light in different portions. The observers at the Perkins Observatory have promised to continue the series; the plates will be measured at Leyden. The work of Dr. Hins and Mr. van Herk in Kenya is nearly completed. Its object is to obtain fundamental declinations by observations of the azimuths of stars when they are moving vertically in the east and west. The results should be free from the uncertainty due to refraction. The time spent at the station was too short to give a complete catalogue of fundamental declinations; all that was aimed at was to give a full test to the possibilities of the method, in the hope that it may be carried out on a larger scale.

Plates for the determination of proper motions in the Pleiades continue to be taken under the direction of Prof. Hertzsprung; Mr. Uitterdijk examined the proper motion of the star 190 in the cluster N.G.C. 1647; it was suspected that this was a white dwarf accidentally superposed on the cluster, but the observations show no appreciable relative motion, so that it belongs to the cluster and is not a dwarf.

Several members of the staff went to America for last year's solar eclipse and the meeting of the International Astronomical Union at Harvard; Prof. Hertzsprung took advantage of his visit to Harvard to obtain estimates of the magnitude of variable stars from the immense series of plates that are now rendered easy of access by the new buildings erected for them. A 16-inch equatorial is being constructed for the observatory by the firm of Sir Howard Grubb, Parsons and Co. This will be erected in the grounds of the Union Observatory, Johannesburg, by kind permission of the latter, which has for many years been carrying on a scheme of joint work with Leyden.

Botany in Russia

NUMBERS 1-5 of vol. 27 of the *Bulletin of Applied Botany, of Genetics and Plant Breeding*, issued at Leningrad, 1931, under the editorship of Prof. Vavilov, director of the Institute of Applied Botany, present a most impressive picture of the vigorous research along purely scientific lines, as well as into applied problems, which is proceeding in the U.S.S.R. In all, these five numbers contain more than two thousand pages. The papers are in Russian but are generally accompanied by English abstracts, upon which the following notes are based.

In the first number, G. A. Lewitsky summarises the work carried out in the cytological laboratory of the Institute of Plant Industry in the period 1927-30. The investigations have been governed by no less ambitious an aim than the discovery of the variations undergone by the nucleus during the process of evolution. This obviously involves studies linking cytology with systematics, and the work began with the genus *Festuca*. Here it was found that the polyploid multiplication, now so well known to the cytologist, penetrated into even the last subdivisions of the genus made by the systematist. The work then spread to the karyology of the whole great family of the Gramineæ, on which a monograph by N. P. Avdulov is now being published. This work has revealed another type of chromosome variation, affecting the individual units of the haploid group. In the Gramineæ, it is concluded, the basic number of chromosomes has diminished with evolution, from 12 and 10 in primitive types to 7 and 5 in more specialised stocks; along with this has proceeded a change from the tiny dumb-bell shaped chromosomes of the Oryzæ and Panicoideæ to the larger worm-shaped chromosomes of the Poæoideæ.

Such researches necessitated the elaboration of methods of elucidating the morphology of the chromosomes, and the present volume consists largely of papers describing the methods thus developed and the results obtained. The relation of chromosome morphology to systematic affinity is elucidated in an intensive study of the sub-family Helleboreæ. A paper is also included upon the alterations induced in the chromosome by X-rays. The whole volume describes an intensive study upon fundamental cytological problems and it is to be hoped the results may be rendered more accessible to non-Russian workers.

No. 2 contains several important papers upon cereal breeding and upon genetical studies with other economic crops; in particular, British cereal breeders will be interested in the studies of A. A. Orlov on the collection of barleys in the Institute of Plant Industry and of V. V. Suvorov on the Russian barleys. Orlov concludes that the barleys of Abyssinia and Eritrea are at the present time in a stage of an "impetuous creative process"; a re-arrangement of hereditary characters is proceeding actively and a number of new forms originating. Barleys are thus turning up which are very important from an agronomical point of view and have great biological plasticity.

Papers are also included upon the baking properties of mixtures of wheats and upon the connexion between physical and chemical characteristics of the wheat grain and the yield of flour. V. M. Kalashnikov has a paper upon breeding experiments with 'guayule' (*Parthenium argentatum* Gray) which is

apparently to be tried in Russia as a home-grown source of rubber.

No. 3 contains more than 650 pages upon the forest studies and work on forest products carried out under the guidance of E. E. Kern. These studies of the possibilities of native trees and the behaviour of introduced species have naturally great interest for foresters.

No. 4 contains a more miscellaneous series of papers arising out of Russian genetical studies. T. Asseyeva continues her important studies of bud mutations in the potato. She has now more than 150 mutants under study and concludes that in an overwhelming majority of cases they show the structure of periclinal chimæras.

Percival had suggested that the number of veins in the coleoptile might have systematic value (*Ann. Bot.*, 41, 1927) and M. S. Jakovlev and E. I. Nikolaenko have tested this character over a much wider range of wheats. It appears to have systematic value but to lead to conclusions different from those drawn by Percival, especially in connexion with the Abyssinian wheats. Studies upon rice and upon the durum wheats of the northern Caucasus are also included in this part.

No. 5 contains the results of investigations carried out in the physiological laboratory of the Institute of Plant Industry under the general direction of N. A. Maximov. Naturally, therefore, studies on photo-periodism and upon water relations predominate. V. Rasumov has an interesting paper upon the effects of altering length of day upon tuber formation in a number of races of *Solanum* which had been collected by the Institute in an expedition to South America. Tuber formation in *S. tuberosum* seems to be unaffected by day length, but in several other species a delay is induced by exposure to a longer day.

Jrene Borodin has studied the inter-action of important mineral nutrients upon the reaction of barley and millet to changes in length of day; nitrogen deficiency affects this reaction in barley in an opposite manner to phosphorus or potassium deficiency. The work points to the conclusion that the carbohydrate-nitrogen ratio is not the immediate cause of the change from the vegetative to the reproductive phase but an associated phenomenon. The same conclusion is suggested by V. Rasumov's study of the localisation of photo-periodic effect, which suggests, like similar American work, a direct effect of the period of illumination upon the growing centres.

Sophie Tageeva has an interesting study of photosynthesis under long and short day conditions, which leads to the conclusion that this process proceeds at about the same rate in the plant, however long the period of illumination. On the other hand, a 'long day' plant, like oats, shows under short day conditions a considerably greater accumulation of substance than with a long day, an accumulation which must now be explained otherwise than by a more efficient photosynthetic activity.

Th. V. Bystrikov has a very interesting study of the root system of competing cultivated plants, in which what are defined as secondary crops oust primary crop plants, like wheat, flax, etc., because of a more rapid development of aerial parts and a profuse branching of a more vigorous root system. He states that, in opposition to the views of the textbooks, the

primary roots of the cereals do not die off early but remain intact and vital until the beginning of harvest.

Mme. Krasnosselsky-Maximov has attempted to elucidate the internal causes delaying reproduction in the winter forms of cereals. She is led to the conclusion that the winter forms contain a substance, possibly a hormone, which causes delay in reproduction.

The specific nature of the studies on moisture relations can only be briefly indicated. Ivan Vasiljev

has a study of the influence of drought upon carbohydrate transformations in wheats. As usual, hydrolysis is increased with desiccation and synthesis with improvement in the water supply. J. N. Kondo has studied the influence of external, as well as internal, developmental factors, upon resistance to drought, whilst S. Kolotov examines the influence of soil moisture as a growth factor, and S. M. Ivanov attempts to determine the frost resistance of plants by changes in the electrical conductivity of the sap induced by frost injury.

Priestley Celebration at the Chemical Society

PRIESTLEY commemoration discourses were delivered before the Chemical Society on April 6 by Sir Philip Hartog, Prof. A. N. Meldrum, and Sir Harold Hartley, and there was also an exhibition of manuscripts, portraits, medals, books, apparatus, and personal mementoes lent by the Royal Society, Dr. Alexander Scott, Mr. G. H. Gabb, Mrs. Arundell Esdaile, Mr. W. C. Priestley, Dr. C. H. Spiers, and Dr. J. A. Newton Friend, or in the possession of the Chemical Society. Unfortunately, few of Priestley's instruments survive, as nearly all of them, together with his books and manuscripts, were destroyed when rioters sacked his house at Farhill, Birmingham, in 1791.

Sir Philip Hartog dealt particularly with Priestley's own peculiar personality and history as a scientific man and theorist, and said that in some ways he had been singularly misjudged. Priestley had an amazing facility for mastering different subjects. He published some fifty works on theology, thirteen on education and history, about eighteen on political, social, and metaphysical subjects, and twelve books and some fifty papers dealing with physics, chemistry, and animal and vegetable physiology. He also knew Latin, Greek, French, German, Italian, Hebrew, Chaldee, Syrian, and began Arabic. The main purpose of his life was one of religion and piety; his love of science, which he regarded as a relaxation, became obvious at a very early stage. He was the pioneer of the introduction of the teaching of science in schools.

Priestley had a clear vision of the value of hypothesis in scientific investigation, and repeatedly expressed his views on the relation of speculation to facts. Sir Philip Hartog examined and totally rejected the familiar statement that Priestley was 'unable to grasp' the new ideas of the composition of water, showing that he was at one time a convert to those ideas, that his attitude was based on his experimental observations, and that he declared himself ready to be influenced by any new and stronger evidence. Sir Philip Hartog summarised his brief appreciation of Priestley's personal qualities in the words: "Priestley was a glory not only of British science, but of British manhood".

Prof. Meldrum divided his discourse into two parts, showing in the first that Priestley, by his work on gases, made a contribution to science that is unique, and in the second exhibiting his work on nitrogen peroxide. He began by examining two problems which arose in the seventeenth century and were pursued in the eighteenth century by Hales, Black, and Cavendish: the absorption and production of air in general, and the existence of gases distinct from air and from one another. Priestley, who owed

much to Cavendish, was self-trained in experimental science; he made the remarkable admission that his knowledge of chemistry was poor and that he was "not a practical chemist". Chemistry, up to his day, had been concerned so much with solids and liquids that its learning and processes were of little avail in work upon strange gases. Priestley was unique in being the first to handle gases boldly, easily, and quickly. Discussing what is meant by the 'discovery' of a substance, Prof. Meldrum said that Priestley got no credit for the discovery of nitrogen peroxide. He then gave an account of Priestley's preparation of nitric acid, his experiments on nitric oxide and nitrogen peroxide, and his production of nitro-sulphuric acid. The work showed his ardour for discovery, the resources of his mind, and his clever hands that nothing could escape.

Sir Harold Hartley said that Priestley's great service to chemistry was the extensiveness of his work, which revealed to chemists the variety of substances which could exist in the gaseous state, their individuality, and the importance of the part they played in chemical reactions. Priestley often ascribed his discoveries to chance, but in this he was unfair to himself, as he had a real genius for taking advantage of the opportunities that fortune offered him, and many of his researches showed that he could follow up a clue with a fine logical piece of investigation. Sir Harold Hartley described some of Priestley's work in connexion with the composition of the atmosphere, with the analysis of air, and with the practical applications of his discovery of oxygen. Priestley determined the relative density of gases, examined the combination of gases by volume, used solubility determinations as a means of identification, measured coefficients of thermal expansion and the conductivity of sound in gases, compared thermal conductivities, made the first experiments on gaseous diffusion, performed experiments with electricity, and was the first photo-chemist.

The secret of Priestley's genius as an investigator was his enthusiastic energy and curiosity, his fertility of mind, the ingenuity and enterprise with which he devised new experiments with the simplest means, his keen observation, his exceptional visual memory, and the rapidity with which he could develop a new investigation. There was behind everything the impelling force of his love for science, his devotion to experiment, and his boundless faith in the possibilities of new scientific discoveries. Dante's phrase well described Priestley's eager restless spirit, fearless and untiring in the defence of liberty and in the quest of truth: "con l'ali snelle . . . del gran disio".

Origin of the Chile Saltpetre

IN the *Chemiker-Zeitung* of February 18, Dr. C. T. Kautter describes some observations which he has made of climatic conditions in Chile, which he believes may throw an interesting light upon the origin of the saltpetre deposits.

In 1924, Prof. Stoklasa suggested that the formation of these beds might be due to a combination of volcanic and bacterial action, the latter being catalysed by radioactivity. In support of his views he investigated a series of samples of caliche in which he was able to determine the existence of 80×10^{-12} gm. radium per gram of mineral. That not only the deposits themselves but also the overlying atmosphere should exhibit radioactivity appears to Kautter to be probable though unimportant. He brings forward the suggestion that the formation of nitrates can be explained by well-known physico-chemical changes which are independent of radioactivity.

The district of northern Chile in which the nitrate is found is undoubtedly volcanic in character and the vastness of the deposits and the absence of characteristic fossils have led to the abandonment of the idea that the caliche is of animal or vegetable origin. The violent thunderstorms which occur with great frequency in the high mountains in the summer are accompanied by discharges at such high potentials that the conditions for the production of nitric oxide are most probably fulfilled. Further oxidation of this gas to nitric acid and its subsequent action upon the common salt which is abundantly supplied by volcanic action would lead to the formation of sodium nitrate, but the transference of the latter to the nitrate zone, some hundred kilometres farther westward, is not so easy to comprehend, for the geological evidence seems to be against the idea of transference by sedimentation.

Now it has perhaps not been sufficiently well recognised that the nitrate zone, which extends about 100 km. inland from the coast and lies between lat. 19° and 26° S., is particularly subject to the visitation of immense cloud-banks of fog, which rise

almost vertically to a height of about 1,000 m. against the coastal heights before being carried inland. Close observation has shown that these banks of cloud operate only within a limited and fairly well-defined area, with its centre at the coast and extending to the prairies or pampas, which lie at distances varying from 30 km. to 80 km. from the coast-line. It is significant that the greatest accumulation of cloud is to be found overlying the zone which is richest in caliche. Now these thick clouds, which often hang for long periods over the nitrate zones, may serve as transporters and condensers of the oxides of nitrogen which are formed by the frequent electric discharges. It is also suggested that nitrogen may become activated during the evaporation of the water, though this has not been experimentally verified.

Good deposits of caliche are frequently found not only in the valleys or plains but also at overhanging cliffs on the mountain-sides, wherever any resistance to the flow of the cloud may be offered. These arrested portions of cloud are eventually dispersed by the sun, when the nitric acid is deposited. Further confirmation of this theory is to be found in the fact that isolated deposits of caliche can be traced to the breaking away in certain areas of patches of cloud which drift away from the main areas of concentration.

Thus the deposits of nitrate are formed by the gradual evaporation of the clouds in the enormous basins in the mountainous regions. Even the relatively high concentration of iodine in the caliche, which has sometimes been quoted as evidence in favour of its production from organic remains, can be satisfactorily accounted for on this theory. The iodine content of the air is particularly great at the sea-level. It is stabilised by oxidation by ozone and nitrogen peroxide to iodic acid. Thus the author draws the interesting conclusion that in this case Nature adopts much the same process as that in operation in modern technology, namely, the combined action of water, air, heat and electricity.

Ecology of the Lucerne 'Flea'

THE so-called lucerne 'flea', *Smynturus viridis*, is an insect of the spring-tail group (order Collembola) which is widely spread in Europe. It also occurs in the southern hemisphere, where it has most probably been introduced and, in South Australia, it has become a major pest of lucerne. It is a common insect in Britain and, taking advantage of this fact, Mr. D. Stewart MacLagan has made an extensive study of the rôle of environmental factors in relation to the normal natural increase of the *Smynturus* population.

Under the title of "An Ecological Study of the Lucerne 'Flea'", Mr. MacLagan has published (*Bull. Entom. Res.*, 23, 101-145 and 151-190; 1932) observations carried out, in the main, at the Imperial Institute of Entomology Laboratory at Farnham Royal (Bucks). It is not possible to enter into a detailed consideration of the many important points that are discussed by Mr. MacLagan. In addition to studying the bionomics of the insect, and the effects of predators and parasites upon its survival, a critical analysis of the part played by the physical environment is also presented. The

influence of temperature, humidity and soil pH values upon growth, fecundity, and longevity are very fully explored and a general estimate of these combined environmental effects is given. While the first paper is devoted largely to experimental laboratory studies, the second contribution is concerned in the main with the analysis of field data, and the two lines of approach are discussed in conjunction by the author in his conclusions. The value of climatological studies, when checked and analysed by laboratory experimentation, is considered with special reference to the prediction of the possible geographical range of the insect.

The author concludes that the analysis of the complex of environmental factors is an essential preliminary to the study of biological methods of control. The physical environment, he claims, assumes the major rôle in the control of insect populations since it exercises a profound influence on predators, parasites, and hosts alike, resulting in a maze of often unsuspected relationships. Mr. MacLagan's papers form an important contribution to the exact study of animal ecology and are to be commended to the notice of all students of the subject.

University and Educational Intelligence

LIVERPOOL.—Through the gift of Mr. William Horton, the Science Library has gratefully received a sum of money, to be expended over a period of seven years, towards the maintenance of science journals.

The Senate and Council have resolved to confer honorary degrees at the summer graduation on the following: Mr. Stephen Gaselee, librarian and keeper of the papers at the Foreign Office, Miss Eleanor Constance Lodge, until recently principal of Westfield College, London, Prof. G. I. Taylor, Yarrow research professor of the Royal Society, Sir J. Eric Drummond, secretary general of the League of Nations, Mr. R. D. Holt, chairman of the Mersey Dock and Harbour Board, Mr. F. W. H. Groom, until recently head of the Liverpool Institute, the Rev. Father Joseph Howard of Liverpool, Miss D. C. Keeling, secretary of the Liverpool Personal Service Society, and Mr. Percy J. Robinson, chief electrical engineer of the City of Liverpool.

Huddersfield Technical College has been able to report a record attendance of students during the past academic year, the increase in the number of day students (461) being specially marked. The volume of work has increased by 121 per cent since 1920, when a new Textile Department was opened. Among other developments reported by the Principal are the formation of additional practical classes to meet the extraordinary demand for instruction in smoke abatement and fuel economy and provision for helping unemployed adult engineers by reserving the workshop at certain times for fitters, turners and machinists who wished to practise their trade and to use machines of which they had had no previous experience.

MEXICO's new rural schools, known as "Houses of the People", are described in Bulletin No. 11 of 1932 of the United States Office of Education, a brief summary of which appears in the November issue of *School Life*. They are the product of a bold scheme designed to build a new civilisation incorporating a revival of the best features of indigenous culture—Mayan, Toltec and Aztec as well as that of the Spanish conquistadors. The federal government selects and pays the teachers and buys the books, but the local community provides the building and equipment and guarantees an ample attendance of both children and adults. As soon as the teacher has been selected, the building of the school is begun, the labour being provided by the community, men, women, and children, working under the direction of the teacher and using materials (adobe brick) obtained locally. Classes are conducted meanwhile in the open air. Courses are not prescribed by the central authorities but the teacher who lives in and knows the community is left to initiate projects of education adapted to local needs. Health, including dietetics, is a basic school subject and the teacher undertakes such simple medical service as vaccination and dispensing remedies for common complaints. The school garden and playground are regarded as indispensable adjuncts. How Mexico finds teachers competent to perform the varied tasks demanded of them is not explained. Hitherto an enthusiastic belief, on the part of teachers and taught, in the value of the scheme appears to have overcome all obstacles to its success.

Calendar of Nature Topics

The Ice Bridge

The Great Lakes of America and the waterways of the St. Lawrence and its estuary are firmly frozen over every winter. The ice begins to break up towards the end of March, and from the middle of April to the middle of May large quantities of drift ice are swept down into the Gulf of St. Lawrence. The opening of this Gulf is almost entirely blocked by Newfoundland and Cape Breton Island, and nearly every year the gap between these islands is completely filled by great masses of ice. This block sometimes lasts for three weeks; it completely prevents the passage of ships, and is known as 'the Bridge'. As many as 300 ships have been held up at one time, and the Bridge is the cause of frequent wrecks on the coast of Newfoundland.

Clover Mites Invade Dwelling Houses

Clover mites (*Bryobia pretiosa*) live amongst grass and upon the twigs and foliage of many fruit trees. In late autumn the females deposit eggs which hatch in spring, and during April the newly hatched individuals have been known to invade dwelling houses in enormous numbers. In such a case investigated by the writer in 1929, the mites appeared on the outer wall of a house near Edinburgh, on the window sills, and within the house upon the woodwork of the window and shutters, in such numbers that although each mite is less than a millimetre in length, their presence attracted the notice of the householder and was regarded by her as disturbing and troublesome (*Scot. Nat.*, 1929, p. 126). The house was recently built and the explanation of the invasion was that close to it was a grass plot, part of the original pasture field in which the site had been chosen. The invasion lasted several weeks, but the thorough spraying of the grass plot with an insecticide put an end to the plague. In the United States there are records of large numbers of clover mites invading houses, but there the invasions have taken place in the autumn.

The Lambing Season in Great Britain

The peak of the lambing season occurs in spring and indeed it is one of the accepted signs of spring for general observers. Watching the young lambs in field or fold, we may not realise that a farming enterprise of some uncertainty is in progress, in which success or failure depends on a high degree of skill on one hand and much applied science on the other. It is a case of the economical production of an article intended for a discriminating market. The first problem is the choice of suitable breeds of both ram and ewe, and this in itself is no simple matter. In a recent survey of the south-west counties of Great Britain, it was found that no less than 82 distinct crosses were in use. Prolificacy and hardiness in the ewe, with early maturity and quality in the offspring, are the main points looked for, and thus an exacting standard is set up.

The first few weeks of life present many dangers both to mother and offspring, and even under good management serious losses are not uncommon. When this critical stage has been passed a keen watch for disease must still be kept. Veterinary science has already done much to mitigate the effect of internal parasites and foot rot (a virus disease), but there are

still obscure troubles, mostly associated with land which has been overstocked with sheep, that cause much unthriftiness and loss.

Knowledge is being sought in two directions. The scientific study of well-recognised problems of nutrition or disease: and the sifting of the very large body of experience which at present exists in an unavailable form in the minds of keen observers—the flockmasters and shepherds themselves. The partnership should turn out to be a very helpful one: the practical man with a highly developed live-stock sense bringing his problems to the scientific expert, and perhaps from his empirical knowledge providing some useful clues for their solution.

Breeding Haunts of the Harp Seal

When the 'fishing' of the whalebone whales in the North Atlantic came to an end, and the whalers from British ports turned to sealing, it was reckoned a lucky day if the ship struck a breeding place of the harp seal (*Phoca groenlandica*) in the early part of April, for then the crew would be able to slaughter as many as the ship could hold. The reason was that the harp seal is gregarious and in those days was also exceedingly numerous, so that, as Dr. R. W. Gray has quoted from a description written in 1870 by his father, a great whaling and sealing skipper, "fifteen or twenty years ago a pack of [breeding] seals extended in every direction as far as could be seen with a good telescope from a ship's mast-head, lying as close as a flock of sheep"; or as Gravill, a Hull whaler and sealer, said, "I've seen them in Greenland [meaning the Greenland Sea] extending on the pack [ice] for a distance of twenty or thirty miles, young ones and old, just a solid body of seals". (*Naturalist*, 1932, p. 183.) The reason why every sealing ship did not return laden when such plenty existed, was that the breeding places were not fixed, their position depending upon the ice conditions and food supply in the Greenland Sea. The harp seal, so named because of the shape of the curious dark line which seems to be stamped on the white coat of the adult, breeds upon the margin of the arctic ice, where it is breaking up into pack ice, for there the seals have at the same time support for their young and the possibility of abundant food in the sea about the ice-floes.

Food of the Harp Seal and its Significance

Harp seals feed upon the small crustaceans in the plankton of northern seas. Dr. R. W. Gray found them to contain *Euthemisto libellula* and *Nyctiphanes norvegica*; and if they also devour the fishes which live upon the plankton, none the less the distribution of the crustacean plankton is of vital significance. Here is a link which connected the whaling and sealing of the nineteenth century, for harp seals and whalebone whales take advantage of the same food supply, so that often enough the whales were captured amongst the floes upon which the seals were breeding. Dr. Gray has analysed, in the paper referred to above, the records contained in the log-books of certain of the Peterhead sealingships from 1862 until 1891, and has tried to explain the distribution of the former breeding places in relation to the food supply.

The harp seals usually produce their single young in March in about lat. 73° N., north-east of Jan Mayen, where the ice forms a great easterly projecting point exposed to the swell of the ocean on three sides, termed by the old sealers 'the point or

end of the sealing ice'. The very large numbers of seals demanded an enormous amount of crustacean plankton. The presence of such abundance, together with pack-ice suitable for the seals, determined the breeding place in lat. 73° north-east of Jan Mayen or in long. 12° W., west or south-west of that island. In years when the western waters were covered by solid ice, and so were locked up from the seals, the breeding place was confined to the eastern position; whereas if the eastern waters were entirely free from ice, and so for another reason were unsuitable for breeding seals, the herds moved to the localities west or south-west of Jan Mayen.

Societies and Academies

LONDON

Physical Society, Feb. 17. M. C. MARSH: The transmission of heat through fabrics. The results obtained in earlier papers have been analysed to determine the effects of air permeability and of perforations on the thermal insulating properties of fabrics. It is also shown that there is a heat-interchange between the convection currents and the fabric which is important in considering the flow of heat through such insulators. L. F. BATES and B. J. LLOYD EVANS. A compact electromagnet for general purposes. Special attention has been paid to the construction of the coils, which are cooled by the circulation of oil. J. V. HUGHES: On the spurious ring exhibited by fluorescent screens. The spurious ring exhibited by fluorescent screens used for the observation of electrons is explained as being due to total internal reflection of the light at the upper surface of the glass block of the screen. The theoretical intensity-distribution is deduced and is compared with experiment by the use of a specially designed photometer. N. THOMSON: The direct recording of relative intensities by means of a microphotometer. An addition to the usual form of recording microphotometer, giving a record on which ordinates are linearly proportional to light-intensities.

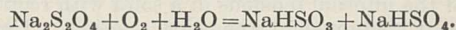
Geological Society, Feb. 22. T. E. LONGFIELD: Subsidence of London. This subsidence has been confirmed by a recent, and still continuing, re-levelling of London. The principal lines of levels in this area have been completed and it was primarily from these that the deductions have been made. A comparatively new method is described by which levels can be transferred across water up to a distance of about a mile; this method has enabled the levelling network to be connected with accuracy across the estuary of the Thames at Dagenham and Tilbury. Evidence of (1) a more or less general sinking in the area of the south-eastern counties, and (2) a fairly general subsidence in the Metropolitan area has been obtained. As regards general sinking, the observations showed that the land surface at Felixstowe is lower relatively to mean sea-level by 0.17 ft. than it was fifteen years ago, and if this scale is maintained it would give a subsidence of 1.2 ft. per century, a figure which is of the same order as that arrived at by the estimated lowering of the Neolithic deposits and Roman remains in the Thames Valley, which were respectively 60–70 ft. and 12–15 ft. below mean sea-level. If the results of the first geographical levelling of Great Britain are taken at their face value, these also suggest a lowering of the south-eastern counties by 1–2 ft.

since 1850. A fairly general subsidence has been found in the Metropolitan area; it appears to commence in each case where the London Clay gives place at the surface to gravel, and reaches local maxima in areas of alluvium and over such erstwhile rivers as the Tyburn and the Wall-brook. The draining of water from the gravels is suggested as the cause of this subsidence.

PARIS

Academy of Sciences, Feb. 27 (*C.R.*, 196, 581-652). The president announced the death of Johannes Schmidt, *Correspondant* for the Section of Anatomy and Zoology. ELIE CARTAN: The spaces of Finsler. A. COTTON: The construction of thermoelectric elements. The suggestion of A. Egal regarding the construction of thermoelectric elements had been anticipated by Wilson and Epps in 1920. CHARLES NICOLLE and J. LAIGRET: The extension of the immunising power of exanthematic viruses by combining the action of two viruses of different origin. C. GUTTON and M. LLE. M. CHENOT: The propagation of electrical oscillations along a tube containing an ionised gas. E. J. GUMBEL: The meaning of the constants in the Gompertz-Makeham formula. ALFRED ROSENBLATT: Some theorems of the theory of ordinary non-linear differential equations of the second order. GEORGES GRAUD: The validity of Fredholm's theory for certain non-limited nuclei. A. MARCHAUD: The criteria of unicity and of multiplicity by integrals of a system of differential equations of the first order. EUGÈNE BLANC: A differential property of the *continus* of Jordan. E. CRAUSSE and J. BAUBIAC: Transitory regimes. Experimental study of the transition regime corresponding to setting a viscous liquid in motion starting from rest. Reynolds's law of similitude applies to all the cases studied. HENRI MIMERY: A remarkable epoch of solar activity (first fortnight in February). From the data available (1880-1933) the author deduces that the sunspots show a tendency to accumulate at certain dates, about the first fortnight in February. ERNEST ESCLANGON: Remarks on the preceding communication. The conclusions in the preceding paper must be accepted with reserve since it would lead to the surprising conclusion that there is a connexion between the production of sunspots and the period of revolution of the earth round the sun, a connexion which logically must be extended to the other planets. E. PRÉVOT: The influence of the daily oscillations of the vertical on the results of high precision levelling. Attention is directed to the possible consequences of the thermal oscillation of the vertical upon exact geodesic measurements. J. SOLOMON: The theory of the diffusion of neutrons. JEAN JAFFRAY: The high-frequency currents produced by high-tension magnetos. If the spark gap is short-circuited, high-frequency currents are still produced; the frequency is independent of the velocity of rotation of the magneto. NICOLAS PERAKIS and LÉANDRE CAPATOS: The constant paramagnetism of metallic rhenium. Over the temperature interval +20° C. to -79° C., rhenium possesses a paramagnetism independent of the temperature: the coefficient of magnetisation found was about eight times that found by Albrecht and Wedekind. The difference does not appear to be due to impurities. RENÉ WURMSEER and MME. NÉLIECIA MAYER-REICH: The equilibrium between lactic and pyruvic acids. PIERRE ACHALME:

The chemical nature of the neutron. If it is assumed that the absolute value of the charge of the negative electron is double that of the positive charge of the proton, an assumption which is in contradiction with no known experimental fact, then the neutron would be formed by the intimate union of two protons and an electron, and would have an atomic weight 2. The author adduces some experimental evidence in support of this view in connexion with the allotropic states of hydrogen. MAURICE NICLOUX: The oxidation of sodium hydro-sulphite by free oxygen. The author's experiments are consistent with the reaction



EMILE ANDRÉ and ARMAND BLOCH: The presence of ether-esters of glycerol in various elasmobranch liver oils and some analytical characters peculiar to these oils. MARCEL GODCHOT and MAX MOUSSERON: Two methylamino-cyclohexanols and their resolution into their optical antipodes. L. PALFRAY, S. SABETAY and M. LLE. DENISE SONTAG: The potash dehydration of the β -phenylethyl alcohols halogenated in the nucleus. The halogen styrolenes. PIERRE BEDOS and ADRIEN RUYER: The oxide and polyalcohol derivatives of 1.3-cyclohexadiene. M. LLE. SIMONNE CAILLÈRE: Study of the thermal dissociation of the serpentine minerals. P. FASTERÉ: The measurement of the reflective powers of some natural tellurides by the photoelectric method. FERNAND BLANCHET: The age of the Guillestre marbles, a rock characteristic of the Malm of the Briançonnais. PAUL BERTRAND: The specification of the *Cladocylon* and *Clepsydropsis* of Saalfeld. RAYMOND-HAMET: The botanical origin of the drug known under the name of *Muirá Puama*. R. GAUTHERET: Cultures of cells detached from the root cap. LAURENT RAYBAUD: The advantages of germinated grain for feeding farm animals, especially the horse. M. ARON and J. COMSIA: Experimental researches on the rôle of functional stimulation in the development of the digestive apparatus in the larvæ of *Rana*. EMILE HAAS: The accommodation effort of corrected ametropes. JEAN ROCHE and PIERRE DUBOULOZ: Study of the constitution of the hæmocyanins and hæmerythrins by means of their ultra-violet spectra. F. PASTEUR: High-tension galvanic electrotherapy.

ROME

Royal National Academy of the Lincei, Dec. 4. F. ENRIQUES: (1) Certain invariant series of groups of points on an algebraic surface. As an extension of Severi's investigation of rational series of groups of equivalent points on a surface, the construction of an invariant series of groups of points having absolute invariance is considered. (2) Arithmetic irrationalities occurring in the plane representation of the rational surface with elliptical sections of the eighth order. U. CISOTTI: Translo-circulatory current in presence of a circular obstacle furnished with an indefinite rectilinear appendix. Q. MAJORANA: A new photoelectric phenomenon exhibited by metallic sheets. The increase in the electrical resistance of thin sheet metal under the influence of light is confirmed, and the experimental results previously described modified slightly. Thus silver, although it displays selective sensitivity towards wave-lengths of less than 3000 Å., is still sensitive to higher wave-lengths. Further, all the other metals tried, with the exception of aluminium, are distinctly sensitive to ultra-violet

light. Various means are available for distinguishing between this effect and the thermal variation of the resistance. G. QUAGLIARIELLO: The presence, in the cells of adipose tissue, of a dehydrogenase acting on higher fatty acids. An enzyme, with an action similar to that of the enzyme recently detected in bile, occurs in adipose tissue. A. COMESSATTI: The canonical series of an algebraic surface. F. TRICOMI: A transcendent equation of statics. M. KOURENSKY: The integration of the equations to partial derivatives of the second order with two functions of two independent variables. (3) Systems containing four derivatives of the second order. R. ZOJA: Distribution of the internal tensions in a solid with rectilinear axis and rectangular transverse section. Uniform distribution of the tangential tension (5). M. BOSCOLASCO: Magnetic measurements at Mogadiscio. Measurements of the magnetic elements during August and September, 1932, show that the secular magnetic variations at Mogadiscio have continued during the past six years, but appreciably more slowly than previously. O. BOTINI: Relationships between the chemical composition of the soil and that of its colloidal contents. Treatment of three alluvial soils free from lime, by washing with water and decantation, shows that, in such soils, chemical decomposition tends to lixiviation of the bases and silica and so leads to the accumulation of ferric oxide and alumina. Comparison of the elementary composition of the soil with that of its colloidal contents gives an indication concerning the degree to which the soil has undergone degradation: the greater the degradation, the more nearly do the two compositions approach equality.

VIENNA

Academy of Sciences, Dec. 1. ERICH TSCHERMAK: Petaloid formation of the calyx in *Phaseolus multiflorus*. The formation of a coloured, corolla-like calyx, previously observed with garden primulas and auriculas, *Soldanella pusilla*, *Cyclamen europæum*, etc., has now been found in three individual hybrids of *Phaseolus vulgaris* and *P. multiflorus*. ROBERT SCHWINNER: Geology of Eastern Styria: the rocks and their inter-relationships. The rocks occurring in this district, especially in the mountainous district between Feistritz and Lafnitz, are described.

Dec. 9. FRIEDRICH LECHNER: Vibrations of certain systems of valency forces with four mass-points. GUNTHER LOCK: Cannizzaro's reaction (2). In continuation of earlier work, further halogenated derivatives, especially chlorobromo-derivatives, of *m*-hydroxybenzaldehyde, have been subjected to Cannizzaro's reaction. The observation that this reaction occurs only with those derivatives which contain at least one hydrogen atom adjacent to the aldehyde group, is confirmed. KARL GIRKMANN: The calculation of cylindrical liquid-containers in relation to wind pressure. OTTO LICKENBERG: Geological and palæontological investigations in the northern Osterhorn group (Salzburg) (2).

Dec. 15. KARL PRZIBRAM: (1) Recrystallisation and coloration (3). The blue colour change of compressed, irradiated rock salt may be followed down to a loading of 100 kgm. per sq. cm. and a strain of about 2 per cent. The velocity of recrystallisation must be regarded as a function rather of the strain than of the pressure. The repression of the recrystal-

lisation by irradiation previously observed has been confirmed by further experiments with specimens subjected to pressures of 10,000 kgm. (or more) per sq. cm. and also with potassium chloride and bromide; the last salt exhibits especially rapid recrystallisation. (2) Plasticity and hardness of crystals of alkali metal halides. The empirical plasticity law found earlier has been verified by numerous tests with sodium chloride and has been extended to potassium chloride and bromide. Measurement of the Brinell hardness of the three salts reveals, *inter alia*, strengthening by pressure and weakening by recrystallisation. HILMAR SCHUMANN: Petrographic phenomena in the Seckauer Tauern. FRIEDRICH KÜMEL: Outliers of the upper crystalline in the Rosalien Mountains. F. WERNER: New Greek Orthoptera from the region of the Aegean Sea. Observations during November at the Central Office for Meteorology and Geodynamics, Hohe Warte, Vienna.

Official Publications Received

GREAT BRITAIN AND IRELAND

Report of the Rugby School Natural History Society for the Year 1932. (Sixty-sixth Issue.) Pp. 43. (Rugby: George Over, Ltd.)
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